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The Whole delivered in a plain and eaſy Manner, for the conveniency both of Maſter and Scholar.

By JACOB WELSH,
Maſter of the Academy in *Silver-Street*, *Golden-Square*.

Printed for George Keith, in *Grace-church-Street*.
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My Lord and Gentlemen,

IF Dedications are Compliments, (as in the Manner generally handled they certainly are) none can have a better Title to my Reſpect and Gratitude than your Lordſhip, &c. However, as I am unacquainted with the adulatory Stile of a Dedicator, and that one kind of Compliment cannot ſuit all my honourable and worthy Subſcribers addreſſed in a collective and indiſcriminate Manner; I can only expreſs my

Senſe of the Obligations conferr'd, in general Terms, for which I return my unfeigned Thanks; and as a Proof of my Sincerity, do promiſe to give any reaſonable Aſſiſtance to any Subſcriber needful for the underſtanding or ſolving of any thing in either Volume, *gratis.* But as ſeveral of the Subſcribers are far ſuperior in mathematical Knowledge to me, it cannot be ſuppoſed that I preſume to include ſuch in this Propoſal. As to the firſt Volume, I have endeavoured to make it as plain and generally uſeful, as my intended Brevity would admit: But am not ſo vain as to expect the Approbation of all Readers, ſince no ſuch Book was ever yet publiſhed; and it is well known that ſome Perſons read Books with no other View than to ſpy out their Faults, which perhaps, when examined, are only ſome trivial Slips of the Pen or the Preſs: But as theſe little Critics are generally opaque Bodies, who, having no Light in themſelves, endeavour to intercept that of others (and then expect to be highly extolled for their wonderful Sagacity in obſerving thoſe Trifles) I ſhall not regard thoſe Mathematicians in Miniature, while I have the Approbation of competent Judges. Nor do I pretend to any great Merit in the firſt

Volume, wherein I do not propoſe to advance any thing new, as to the Matter of the Science, that being referred to the ſecond Volume: My principal Objections to other Books upon much the ſame Plan being, that I found little or no Variety in their Queſtions, and think them too ſimple to make an expert and ingenious Accomptant, and alſo that they neglect giving Examples to illuſtrate the Rules. Here it may poſſibly be retorted that I have objected againſt the Criticiſm of others, and yet have taken great Liberties therein myſelf, and ſo (Parſon-like) preach a Doctrine which I do not practiſe. To this I anſwer, that I do not condemn Criticiſm in general, but in Trifles only, and an ungenteel or malicious Manner of treating the Author criticiſed. The Anſwer to a Queſtion may be falſe, and yet the general Rule (or Principles) upon which the Solution is founded, true; and in this caſe the Author's Abilities cannot, in juſtice, be called in queſtion, ſince this may not be an Error of Judgment, but a Miſtake in the numerical Work, &c. or perhaps an Error of the Preſs: But all Errors or Defects in general Rules are of conſequence, and not only may, but ought to be detected by any Man who is able to prove the Error, and to rectify the Rule. And that all the Corrections I have made (except that of Mr. *Clare*'s 6th Queſtion, Recreation 15.) are of this ſort, will, I preſume, be allowed, they being of general Rules. And this I have mentioned chiefly by way of Apology, and to prevent unneceſſary Cavilling; but ſhall thankfully accept any neceſſary Direction or Information concerning Things material.

I am,

My Lord, &c.

Your moſt obliged,

and moſt obedient,

humble Servant,

J. WELSH.

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Hence the beſt way is to make a double Operation, for then ſo far as they agree is certain, and no farther; or make as many defective as are exceſſive.

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PREFACE.

IT will probably be expected that I ſhould begin with the common Apology for attempting a new Treatiſe of Arithmetic, after ſo many learned Writers upon this Subject: But (in my Opinion) the Public ſhould not be troubled with that Performance which ſtands in need of an Apology; for if there is no real Merit in the Performance, the Publication thereof is an Impoſition upon the Purchaſer, which no Apology can excuſe; and if there is, it ſtands in no need of an Apology; but on the contrary, it is the Author's indiſpenſible Duty to his Benefactors, (eſpecially the Subſcribers, if any) to give a fair and honeſt Repreſentation of his Work, with a particular Account wherein he differs from other Authors, and his Reaſons for the ſame, that they may thereby be enabled to judge whether it ſuits them, and how far it deſerves their Encouragement. Yet I would not be here underſtood to intimate, that any Man ought to ſing forth his own Praiſes, or depreciate the juſt Merit of others, ſince this would indicate his Vanity rather than his Knowledge, and would certainly be juſtly deſpis'd by the more ſenſible Part of Mankind: "Yet (as Mr. *Malcolm* obſerves) it is every Man's "Buſineſs who writes upon any Subject, to correct "the Errors committed by others, eſpecially if they "are of Conſequence." And this (I think) he is oblig'd to do for two Reaſons, *viz.* firſt, for the Benefit of the Public; and ſecondly, for his own Credit, leſt this Omiſſion ſhould be imputed to his Ignorance; nor ſhould the Credit of any particular Perſon be preferr'd to the Benefit of the Public; but then theſe Amendments ſhould be made in a civil Language, and the Perfections, as well as the Errors, ſhould be impartially noted. Therefore, I hope to be excus'd in taking the Liberty to rectify ſome Miſtakes in the following learned Authors, *viz*. Mr. *Kerſey*, Mr. *Hill*, Mr. *Clare*, and Mr. *Malcolm*. Nor can theſe human Frailties be any Derogation to the real Merit of thoſe eminent Gentlemen, ſince they do not (I preſume) pretend to Infallibility; and are (with Mr. *Hatton*) the beſt Authors extant upon practical Arithmetic. Mr. *Clare*'s Arithmetic undoubtedly contains a large Collection of the moſt ingenious Queſtions ſolvable by common Arithmetic, yet publiſhed in our Language: And Mr. *Malcolm* (in my Opinion) has done more upon this Subject (particularly in the Theory) than all the other arithmetical Writers together; but then Mr. *Malcolm*'s Book cannot be underſtood in the moſt material Parts, by any Perſon unſkill'd in the algebraic Art; at leaſt he muſt underſtand ſo much of Algebra as a quadratic Equation; for ſo far (and no farther) Mr. *Malcolm* proceeds algebraically. Nor can any Perſon (unſkill'd in ſpeculative Geometry) thoroughly underſtand the (Reaſon of the) common Rules of Arithmetic, without the Aſſiſtance of Algebra. And I am perſuaded, that if the generality of Merchants knew the great Uſe and Excellency of that ſublime Science, even in the common Affairs of Life, they would be more aſſiduous in ſo uſeful a Branch of Learning; for I dare affirm, that an adult Perſon (who already underſtands the four firſt numerical Rules) ſhall know more of Arithmetic, by ſtudying Algebra three Months, than if he were threeſcore Years ſtudying Arithmetic without it. But concerning the Matter and Form of the Work. In the firſt

Volume, I have given Rules and Examples, ſufficient for all the common Caſes of Arithmetic; and have concluded each Rule with Variety of uſeful Queſtions, to exerciſe the Pupil's Genius, and ſave the Teacher unneceſſary Trouble: Nor will the Compoſition of theſe Queſtions be leſs ſerviceable to the Scholar than to the Maſter; if the Maſter will pleaſe to employ the Time neceſſary for the Compoſition, in explaining the Rules and clearing up all Difficulties to the Scholar. The Rules I have plac'd in ſuch Order as to me ſeem'd moſt convenient; making the more difficult and leſs uſeful Rules ſucceed the neceſſary and ſimple. Fractions I have plac'd after all the Rules in whole Numbers, becauſe whole Numbers are leſs difficult and more neceſſary than Fractions: However every Teacher has a Right to pleaſe himſelf in the Order of the Rules. Then I have ſhewn (as clearly as I could) how to extract the ſquare and cube Roots, reſerving the Extraction of the Roots of higher Powers for the ſecond Volume. To all theſe I have added 80 curious and uſeful Queſtions, to exerciſe all the Rules of Arithmetic promiſcuouſly: However, theſe Queſtions are not to be attempted by any one who is not tolerably expert in all the Rules; but to ſuch as are, they will quicken and confirm their Judgment in the common Rules, and are abſolutely neceſſary for all ſuch Teachers as are unſkill'd in Algebra; ſince a competent Knowledge in theſe Recreations, will be a Defence againſt the inquiſitive unmannerly Behaviour of ſome Perſons, who are fond of propoſing borrow'd intricate Queſtions (which they underſtand not) to Schoolmaſters, hoping to put them to a Nonplus, and thereby (as they imagine) acquire great Honour to themſelves. Alſo, whoever is expert in theſe Recreations, will find no difficulty in Mr. *Clare's*; I mean, ſuch in Mr. *Clare* as are purely arithmetical; having reſerv'd the geometrical Subtilties for my ſecond Volume, where I intend (antecedent to theſe) to ſhew how to meaſure all Sorts of Superficies and Solids, which is more than I (at firſt) propos'd to the Subſcribers. In ſum, I have taken the trouble to compoſe (and work) all the Queſtions myſelf, except thoſe corrected in the foremention'd Authors, and two more, *viz.* Queſt. 2d, p. 52. and Queſt. 2d, p. 78. and have endeavour'd to make the whole as plain and conciſe as poſſible; and to accommodate it both to the Cloſet and the public School. How far I have ſucceeded in my Deſign, muſt be left to proper Judges. I ſhall now treat of the Miſtakes hinted at in the foreſaid Authors.

Mr. *Clare*'s 6th Queſton of his 15th Recreation, I have inſerted in my 5th Recreation, Queſtion 16, becauſe I find Mr. *Clare* miſtaken in his Method of ſolving it, ſuppoſing the Queſtion properly given. Here Mr. *Clare*, in his Solution, makes *B* receive $\frac{1}{4}$ of *A*'s Barter-value in ready Money, without giving any Value in return for ſaid Money; which is a Senſe (I dare ſay) no Man (beſides Mr. *Clare*) will find in the Queſtion; for certainly the moſt obvious Senſe of the Queſtion (if there is any Senſe at all in it) is this, *viz.* *A* is to give to *B* 100 Reams of Paper (at the Barter-value) and a certain Sum of Money, for which Paper and Money he is to receive Pamphlets of *B* at the Barter-price: and then the Solution will be thus, *viz.* add $\frac{1}{3}$ of the total Barter-value of *A*'s Paper to ſaid Barter-value, (which is equal to $\frac{1}{4}$ of the whole) and then find how many Pamphlets (rais'd in the ſame Proportion as *A*'s Paper) are equivalent to this Sum, ſo many Pamphlets muſt *B* deliver to *A*; hence the Anſwer will be thus, *viz.* *A* (beſides the Paper) muſt pay 16 *l.* 6 *s.* 8 *d.* in Money; and *B* muſt deliver $2133\frac{1}{3}$ Pamphlets, and then *B* will gain 3 *l.* 6 *s.* 8 *d.* by the Bargain.

But, Mr. *Clare*'s Anſwer is this, *viz.* *A* pays (beſides the Paper) 12 *l.* 10 *s.* in Money, which is the Sum clear'd by *B*, who delivers 1600 Pamphlets.

In Mr. *Clare*'s 19th Queſtion of the ſame Recreation, where the Barter muſt be ſuppos'd equal, ſince there is nothing in the Queſtion to intimate the contrary, Mr. *Clare*'s Method of Solution is entirely wrong; for there, though *B* pays 16 *l.* 2 *s.* 1½ *d.* (or 16,2,$1\frac{109}{236}$ exact) in Money, Mr. *Clare* raiſes his Brandy in the ſame Proportion as *A* raiſes his Hops; whereas *B*'s Brandy ſhould have been rais'd in a greater Proportion, on account of his ready Money, or elſe *A* ſhould have deliver'd *B* Hops at the ready-money Price for the Sum receiv'd. But it is plain that this queſtion, as Mr. *Clare* has propos'd it, admits no Anſwer at all; for if *B* pays any ready Money (be it ever ſo little) his Brandy muſt (on that Account) be rais'd in a greater Proportion than *A*'s Hops, and conſequently he muſt deliver the leſs Brandy. Hence, I have alter'd the Queſtion, ſo as to admit Mr. *Clare*'s Anſwer. See Recreation V. Queſt. 15.

Mr. *Malcolm* (pag. 562.) finds Fault with the common Rule for ſolving Barter Queſtions, where one of the Parties pays part in Money; which Rule is, —ſubtract the Money receiv'd, both from the ready-money Value and the Barter-value of his Goods who receiv'd ſaid Money, and then proportion the other Man's Barter-price to theſe Remainders.

Malcolm's Rule. " Make *A* deliver Goods to *B* at " the ready-money Price for the Sum receiv'd, and " then find how much of *B*'s Goods (rais'd in the " ſame Proportion as *A*'s) are equivalent to the Re- " mainder of *A*'s Goods."

Now, Mr. *Malcolm* ſays, that the former Rule is without Foundation; for (ſays he) there appears no Reaſon for raiſing *B*'s Price in a greater Proportion than *A*'s; but to me there appears a very ſufficient and evident Reaſon for it; and that is, becauſe *B* has paid part in Money, which Part ſhould have been paid in Goods at the Barter-price: Mr. *Malcolm* again ſuppoſes *B* to receive Goods at the ready-money Price for his Money paid down, and then ſays, if *B* (upon this State of the Queſtion) advances his Goods in a greater Proportion than *A*'s are advanc'd, there is a manifeſt Injuſtice done to *A*; very true, indeed! but who hath Mr. *Malcolm* ever known to proceed in this Manner? for they all (that I have met with) ſuppoſe him who receives the Money, to part with all his Goods (deliver'd) at the Barter-price; and then they raiſe the other Merchant's Goods accordingly; and this (after all) Mr. *Malcolm* acknowledges to be juſt, but calls it a ridiculous round-about Method of Proceeding; which (I imagine) if well underſtood, will be found as ſhort and intelligible as Mr. *Malcolm*'s Rule: for example, in my 12th Queſtion of Barter, *A* receives 3 *s.* 9 *d.* ready Money in every Yard, which reduces the prime Coſt *per* Yard to 8 *s.* 3 *d.* and the Barter-price to 11 *s.* 3 *d.* hence it is plain, that the Price of *A*'s Cloth is not advanc'd in the Proportion of 12 to 15, but in the Proportion of 11 to 15; and conſequently *B*'s Cloth muſt likewiſe be rais'd in the Proportion of 11 to 15. And this, I take, to be full as plain and ſhort as Mr. *Malcolm*'s Rule. Moreover, Mr. *Malcolm*'s Rule is not general (and the other is) for when the Prices only are given, Mr. *Malcom*'s Rule cannot be apply'd.

In Factorage, there are two different Ways of ſtating the Queſtion betwixt the Merchant and Factor, when the latter is allow'd a Share of the Gain for his Service.

1ſt Method. Divide the total Gain between the Merchant and Factor, in proportion to their Stocks, *viz.* the Merchant's real Stock (or full Sum put in) and the Factor's eſtimated Stock.—2d Method. From the Merchant's real Stock ſubtract the Factor's eſtimated Stock, and then divide the total Gain in proportion to the Subtractor and Remainder, giving the Factor that Part of the Gain which belongs to the Subtractor, and the Merchant that Part which belongs to the Remainder.

But Mr. *Malcolm* recommends the latter as the moſt reaſonable (page 557.) which (in my Opinion) has neither Reaſon nor Juſtice in it: My Objections to it are theſe, *viz.* firſt, the Factor will always have a greater Share of the Gain than if his Stock (which is imaginary) had been real.—Secondly, there may be an infinite Number of Queſtions propos'd, wherein the Factor will have all the Gain to himſelf; and this will happen in every Caſe wherein the Factor's imaginary Stock is equal to the Merchant's real Stock; for then, the Subtraction being made, the Remainder will be nothing for the Merchant's Stock; and conſequently he will have nothing for his Share of the Gain. And theſe (I preſume) are ſufficient Reaſons for laying this Method aſide. However (to acquieſce with Cuſtom) I have anſwer'd all my Queſtions according to both Methods, ſee page 117. But Mr. *Malcolm* has juſtly corrected Mr. *Hatton*'s Solution of his third Queſtion in Barter; and Mr. *Hill*'s Solution of his 8th Queſtion in ſingle Fellowſhip, alſo his 8th of Loſs and Gain, and his 7th of Barter; yet the laſt ſeems to be a Miſtake in Mr. *Hill*, rather than an Error in Judgment, ſince he has given a juſt Solution to another Queſtion (*viz.* his 6th) of the ſame Nature. And yet there are two material Errors in Mr. *Hill*, which have eſcap'd Mr. *Malcolm*, *viz.* Mr. *Hill* tells us (pag. 193.) that if we divide 15 *s.* by 3 *d.* (1 *l.* being the Integer) fractionally, the Quote will be 60 *l.* but this cannot be, for the Diviſor and Dividend being here both applicate Numbers, the Quote muſt therefore be an abſtract Number. Or if (according to Mr. *Hill*) the Quote muſt needs be conſidered as an applicate Number, then every Unit in the Quote will be equal in Value to the Diviſor (which holds in all Diviſions) and then the Quote (which Mr. *Hill* calls 60 Pounds) will be but 60 Three-pences; ſee Queſtion 9. page 111. —The next is Mr. *Hill*'s 11th Queſtion of Loſs and Gain (page 291.) where it is evident that Mr. *Hill* has found the preſent Gain *per Cent.* inſtead of the Gain *per Cent. per Annum*, the latter being the Thing ſought in the Queſtion. Therefore the Method there cenſur'd by Mr. *Hill* is the true Method; for the Gain at the Time of Payment is 3 Months Gain, and conſequently the Gain *per Annum* will be 4 Times that Sum. See my 5th Queſtion of Loſs and Gain.

In Diſcompt a great Error prevails among ſome preſent (as well as former) Writers, altho' the ſame has been juſtly corrected in Dr. *Harris* by Mr. *Malcolm*; the Error is, that in finding the Diſcompt of a Sum for any Time leſs than a Year, they take ſuch a Fraction of a Year's Diſcompt as the given Time is of a Year; and ſo for the Diſcompt for $\frac{1}{2}$ a Year, they take the $\frac{1}{2}$ of a Year's Diſcompt, but this Error proceeds from a confus'd Notion of Intereſt and Diſcompt; for by this Method they find the Intereſt of the included Principal, inſtead of the Diſcompt of the given Amount. Now, though the Intereſt of the included Principal for the whole Time is equal to the Diſcompt of the given Amount for the whole Time, yet the Intereſt for any Part of the Time will be leſs than the Diſcompt for the ſame Time; and the Reaſon of the Error is, that tho' they reduce the Rate in the middle Term, yet they do not reduce it in the firſt; and therefore (the firſt Term being too great) the fourth Term muſt be too little.

Here perhaps it may not be improper to take notice of a common Error in duodecimal Multiplication, *viz.* the generality of Meaſurers have a wrong Notion of the inferior Denominations in the Product; for example, the laſt Product in page 106, they not only read as 6 Feet 3 ſquare Inches, but alſo underſtand it ſo, whereas it is 6 Feet and 36 ſquare Inches: alſo the Product in page 107, they read and underſtand thus, *viz.* 1911 ſolid Feet, 7 ſolid Inches, 5 twelfths of a ſolid Inch, and 10 twelfths of one twelfth of a ſolid Inch; but to read this truly, ſee page 107, and proceed likewiſe in other Caſes.

Mr. *Kerſey* in his Appendix to *Wingate*'s Arithmetic (page 322.) ſays, that when (in a Queſtion) ſome Parts of the Number ſought are to be multiply'd the one by the other, then ſuch Queſtions cannot be ſolv'd by the Rule of Falſe; but in this Mr. *Kerſey* is miſtaken; for if (after the Errors are found) we take that Power of the Poſitions, whoſe Index is equal to the Number of the Factors, and work with theſe Powers inſtead of the Poſitions, and then extract that Root of the Reſult, whoſe Index is that of the Root of the foreſaid Power, this Root will be the Number ſought.

Mr. *Kerſey* further ſays (page 322.) that where a Queſtion requires the Number ſought, or ſome Part thereof, to be ſquared, cubed, *&c.* then the Rule of Falſe cannot be apply'd; but the Direction I have given above may be apply'd to this Caſe alſo. Hence it will be found, that the Rule of Falſe is not ſo limited in its Application as is generally thought. (See my 14th Queſtion of Double Poſition.) I ſhall conclude with (part of) the learned Dr. *Barrow*'s Commendation of the Mathematics above all other Studies.

" The Mathematics (ſays he) whoſe Words are ſo " many Oracles, and Works as many Miracles, blabs " out nothing raſhly, nor deſigns any thing from the " Purpoſe; but plainly demonſtrates, and readily per- " forms all things within its Compaſs. Laſtly (ſays " he) the Mathematics depends upon Principles clear " to the Mind, and agreeable to Experience; draws " certain Concluſions, inſtructs by profitable Rules, " unfolds pleaſant Queſtions, and produces wonder- " ful Effects; it is the plentiful Fountain of Advan- " tage to human Affairs. He concludes, that theſe " Diſciplines inure and corroborate the Mind to a " conſtant Diligence in Study; they wholly deliver " us from a credulous Simplicity, moſt ſtrongly for- " tify us againſt the Vanity of Scepticiſm, effectually " reſtrain us from a raſh Preſumption, moſt eaſily in- " cline us to a due Aſſent, and perfectly ſubject us to " the Government of right Reaſon."

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N. B. For an Account of the ſecond Volume, ſee the annexed Contents; where you will find all that is curious in Arithmetic, with ſeveral uſeful Contractions, and Improvements in all the Rules. The whole (except the algebraic Demonſtrations) adapted to common Capacities; and may be underſtood by thoſe who have proceeded no further in Mathematics than common Arithmetic.

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MULTIPLICATION. 1. *To multiply without the Table.*—2. *To multiply by any Number, uſing only one Figure of the Multiplier.*—3. *To multiply without uſing any Figure of the given Multiplier.*—4. *To multiply by any aſſign'd Number of Figures, giving only the Product, by dividing (in an eaſy Manner) by a ſingle Integer.*—5. *To ſquare any Number of 9's by Inſpection.*—6. *To multiply by any repeated Digit, in one Line.*—7. *To multiply by any given Number, in one Line.*—8. *To give the total Value of ſeveral different Numbers of Things, ſold at different Rates, by one Multiplication (or Stating.)*—9. *To multiply different Denominations by ditto, in one Line.*—10. *To multiply by a Fraction, without multiplying by either Numerator or Denominator.*—11. *Multiplication of Decimals contracted, by inverting the Order of the Multiplier.*—12. *To reduce Shillings to Pence, by a new Method.*—13. *To reduce Pence to Shillings by a new Method.*

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every Step of component Diviſion.—8. *To value the Decimal of a Pound by Inſpection.*—9. *To turn Shillings, Pence, and Farthings into the Decimal of a Pound, in one Line, three ways.*—10. *To divide by any aſſign'd Number of Figures, giving only the Quote.*—11. *To divide by any Line of 9's, without any Multiplication.*—12. *To divide by a Fraction, without multiplying by either Numerator or Denominator.*—13. *To divide different Denominations by ditto, without any Reduction.*—14. *Diviſion of Decimals contracted.*—15. *To find the exact Remainder of any Diviſion, without performing the Diviſion, or determining Part of the integral Quote.*

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FELLOWSHIP *contracted in particular Caſes; and a great Variety of new Caſes added.*—INTEREST *and* DISCOMPT *contracted and improv'd.*—ALIGATION *medial and alternate contracted; and a curious*

rious Method of ſolving the latter. — Equation of Payments the true Way, by Malcolm's *Rule.*

PRIMES *and* COMPOSITES. 1. *To find all the Primes, and the Components of all the Compoſites under any given Number.*—2. *To reduce any given Number into its component Primes.*—3. *To find all the juſt Diviſors to any given Number.*—4. *To find all the aliquot Parts of any given Number.* — 5. *To find as many perfect Numbers as you pleaſe.* — 6. *To find the greateſt common Meaſure of any two Numbers.*—7. *To find a common Multiple to any Number of Numbers.*—8. *To find the leaſt common Multiple to two Numbers.*—9. *To find the leaſt common Multiple of any Number of Numbers.*—10. *To reduce Fractions (in their leaſt Terms) to their leaſt common Denominators.*

1. *Harmonical Proportion.*—2. *Permutation, Election, and Compoſition of Numbers.*—3. *The Extraction of all Kinds of Roots.*—4. *Military Orders.*—5. *The whole Doctrine of arithmetical and geometrical Progreſſion.*—6. *Annuities by both ſimple and compound Intereſt.*—7. *Logarithmical and inſtrumental Arithmetic.*—8. *Algebraical Demonſtrations of all the Rules of Arithmetic, and of Extraction of Roots, Progreſſions, Annuities,* &c. *To which will be added the Menſuration of all Kinds of Superficies and Solids, regular and irregular, and their Segments.*

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Long Meaſure.

Inches 3 = 1 Palm.
Palm 3 = 1 Span.
Span $1\frac{1}{3}$ = 1 Foot.
Feet $1\frac{1}{2}$ = 1 Cubit.
Cubit 2 = 1 Yard.
Yard $1\frac{1}{4}$ = 1 Ell.
Ell $1\frac{1}{3}$ = 1 Pace.
Pace $1\frac{1}{5}$ = 1 Fathom.
Fath. $2\frac{3}{4}$ = 1 Pole.
Pole 40 = 1 Furlong.
Furl. 8 = 1 Mile.

Square Meaſure.

Inches 144 = 1 Foot.
Feet 9 = 1 Yard.
Yards $2\frac{7}{9}$ = 1 Pace.
Paces 10,89 = 1 Pole.
Pole 40 = 1 Rood.
Rood 4 = 1 Acre.

Dry Meaſure.

Pints 4 = 1 Gallon.
Gall. 2 = 1 Peck.
Pecks 4 = 1 Buſh. L. M.
Pecks 5 = 1 Bu. Wa. M.
Buſh. 8 = 1 Quarter.
Quar. 4 = 1 Chaldron.
Qu. $4\frac{1}{2}$ = 1 Ch. of Coa.
Chal. 5 = 1 Wey.
Weys 2 = 1 Laſt.

Wine Meaſure.

Solid Inch. $28\frac{7}{8}$ = 1 Pint.
Pints 8 = 1 Gall.
Gallons 18 = Runl.
Runlet $1\frac{3}{4}$ = 1 Barr.
Barrel $1\frac{1}{3}$ = 1 Tierce.
Tierce $1\frac{1}{2}$ = 1 Hhd.
Hhd $1\frac{1}{3}$ = 1 Punch.
Punchin $1\frac{1}{2}$ = 1 Butt.
Butts 2 = 1 Tun.

Ale Meaſure.

Pints 8 = 1 Gallon.
Gallon. 8 = 1 Firkin.
Firkins 2 = 1 Kilderkin.
Kilder. 2 = 1 Barrel.
Barrels 2 = 1 Hhd.

Beer Meaſure.

Pints 8 = 1 Gallon.
Gallon. 9 = 1 Firkin.
Firkins 2 = 1 Kilderkin.
Kilder. 2 = 1 Barrel.
Barrels 2 = 1 Hhd.

Avoirdupois Weight.

Drams 16 = 1 Oz.
Oz. 16 = 1 ℔.
℔. 28 = $\frac{1}{4}$ C.
Quarters 4 = 1 C.
C. 20 = 1 Tun.

Troy Weight.

Grains 24 = 1 Dwt.
Dwt. 20 = 1 Oz.
Oz. 12 = 1 ℔.

Apothecarys Weight.

Grains 20 = 1 Scruple.
Scruple 3 = 1 Dram.
Drams 8 = 1 Oz.
Oz. 12 = 1 ℔.

Foreign

	Foreign Coin.		English Coin.		
French Coins —	A Denier	=	0	0	0 3/40
	12 Deniers = 1 Soulz	=	0	0	0 9/10
	12 Soulz = 1 Livre	=	0	1	6
	3 Livres = 1 Crown	=	0	4	6
Low Country Coins —	A Stiver	=	0	0	1 1/5
	6 Stivers = 1 *Flem.* S.	=	0	0	7 1/5
	20 Stivers = 1 Gilder	=	0	2	0
	10 Gilders = 1⅔ *l. Flem.*	=	1	0	0
	Embden Dollar	=	0	2	3 1/5
	Campen Dollar	=	0	2	7 1/5
	Zealand Dollar	=	0	3	0
	Lyons Dollar	=	0	4	0
	Specie Dollar	=	0	5	0
	Ducatoon	=	0	6	3 3/5
Germany	A Rix-dollar of the Empire	=	0	4	5 3/4
	A Gilder of *Nuremberg*	=	0	7	1
Italy and *Spain* —	The Livre at *Leghorn*	=	0	0	9
	Florence Crown current	=	0	5	3
	Venice Ducat de Banco	=	0	4	4
	The current Ducat	=	0	3	4
	The *Naples* Ducat	=	0	5	0
	The *Cadiz* Ducat	=	0	5	6
	The *Barcelona* Ducat	=	0	6	0
	The *Valencia* Ducat	=	0	5	3
	The *Bergonia* Ducat	=	0	4	4
	The *Portugal* Teſtoon	=	0	1	3
	The Piece of Eight	=	0	4	6

Theſe I have taken from Mr. *Ward*; but as the Courſe of Exchange varies, ſo will theſe Values vary; and therefore the current Courſe muſt always be regarded, and not theſe Values.

ARITH-

ARITHMETICK.

NUMERATION TABLE.

Thouſands of Millions.	Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thouſands.	Tens of Thouſands.	Thouſands.	Hundreds.	Tens.	Units.
1	9	8	7	6	5	4	3	2	1

$$\overset{\substack{m\\m\\m\\m}}{7}21345\overset{\substack{m\\m\\m}}{6}79268\overset{\substack{m\\m}}{4}79324\overset{m}{6}823752.$$

or thus

$$\overset{\overset{4}{m}}{7}21345\overset{\overset{3}{m}}{6}79268\overset{\overset{2}{m}}{4}79324\overset{m}{6}823752.$$

or thus

The ſecond Table read thus:

7 Million of Million of Million of Millions; 213456 Million of Million of Millions; 792684 Million of Millions; 793246 Millions; 823752 Units.

The third Table read thus:

7 Times the 4th Power (or Biquadrate) of 1 Million; 213456 Times the 3d Power (or Cube) of 1 Million; 792684 Times the 2d Power (or Square) of 1 Million; 793246 Millions; 823752 Units.

And thus may any aſſign'd Number be immediately valu'd.

ADDITION OF WHOLE NUMBERS.

RULE.

ADD up every Column (ſeverally) and for every Ten in the Sum carry 1 to the next Column; having put down the reſt under the added Column.

Examp. 45673 + 7
Add 20764 + 1
00982 + 1

Sum = 67419 + 0 = 0 Proof.

To prove Addition by expunging the 9's.

RULE.

Reject all the 9's in every added Line; then the 9's being expung'd out of the Sum of the remaining Figures, and alſo out of the Total of the given Lines; if the remaining Figures are equal, the Anſwer is right, otherwiſe not.— See the Proof of the preceding Queſtion.

SUBTRACTION OF WHOLE NUMBERS.

RULE.

WHEN the under Figure is leſs than the upper, put down the Difference under theſe Figures; but when the under exceeds the upper, add ten to the upper, ſubtract the under from this Sum, put down the Remainder, and carry 1 to the next under Figure.

$$\begin{array}{rrcl}
\text{Examp. from} & 456637 & + & 7 \\
\text{take} & 291348 & - & 0 \\
\hline
\text{Remains} & 159289 & + 7 = & 7 \quad \text{Proof.}
\end{array}$$

$$\left\{\begin{array}{rcl}
946325 & + & 2 \\
62432 & - & 8 \\
\hline
883893 & + 3 = & 3
\end{array}\right.$$

To prove this Rule by expunging the 9's.

RULE.

Expunge the 9's out of the Subtrahend, Subtractor and Remainder. Then,

Subtract the exceſs Figure of the Subtractor from that of the Subtrahend (adding 9 to the latter, if needful) this Remainder muſt be equal to the exceſs Figure of the Difference ſought.

See the Proof of the two laſt Queſtions.

Hence having the exceſs Figure of any two of theſe three, (Subtrahend, Subtractor, Remainder) we can find the exceſs Figure of the other Term, without knowing ſaid Term.

Multiplication of Whole Numbers.

The Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

How to conſtruct this Table by Addition only. Put down the Top and the left-hand Margin Columns; then to form the ſecond Horizontal Column, add every Figure in the upper Column to itſelf, and put the Sum in the next Square under ſaid Figure; and to form every ſucceeding Column, proceed thus, *viz.* to every Figure in the laſt Column add the Figure directly over it in the Top-column, put the Sum in the next Square directly under theſe Figures; and ſo proceed through all.

Or thus:

To the marginal Figure add itſelf, put the Sum in the next Square of the ſame horizontal Column, then to find the Numbers for every other Square in ſaid Column; to the Number in the laſt Square add the marginal Figure, the Sum is the Number to be put in the next Square of ſaid Column.— And thus may any one, unſkill'd in Multiplication, make a Table for himſelf.

To multiply any whole Number by any whole Number.

RULE.

Multiply every Figure of the Multiplicand by every Figure of the Multiplier, ſetting the firſt Figure of every Line (in the Work) under the multiplying Figure, putting down what is under or over Ten or Tens, and carrying 1 for every Ten to the next Product.

Exam.	376485	+ 6
by	6	$+\frac{6}{36}$
Prod. =	2258910	+ 0 = 0 Proof.

Examp. 2d. multiply	3760480	1
by	40600	× 1
	2256288000	1 Prod.
	15041920	
Prod. =	152675488000	+ 1 = 1

To prove this Rule by expunging the 9's.

RULE.

Expunge the 9's out of both Factors (ſeverally) and alſo out of the Product of the remaining Figures; then if this Remainder is equal to the Figure that remains after the 9's are expung'd out of the

Product, the Work is right, otherwiſe not. See the Proof of the two laſt Queſtions.

DIVISION OF WHOLE NUMBERS.

CASE 1ſt. *When the Diviſor is one Figure only.*

RULE.

EXAMINE how often the Diviſor is contain'd in the firſt Figure, or two firſt Figures (if the firſt is too little) of the Dividend; put the Quote under the laſt Figure of the partial Dividend; what remains call ſo many Tens, and add them to the next Figure of the Dividend; then examine how oft the Diviſor is contain'd in this Sum, put the Quote under; and ſo proceed through all the Figures of the given Dividend.

Examp. 8) 76347

Quote 9543 and 3 remains.

CASE 2d. *When the Diviſor conſiſts of two or more Figures.*

RULE.

Seek how oft the firſt Figure of the Diviſor in the firſt or two firſt Figures of the Dividend, but with this Limitation, *viz.* that the Product of the whole Diviſor by the quote Figure may not exceed the correſponding (partial) Dividend; then ſubtract this Product from ſaid Dividend; to the Remainder annex the next Figure of the given Dividend, for the next partial Dividend; and thus proceed till you have us'd every Figure of the given Dividend.

N. B. Firſt, If you divide the firſt Figure of the given Dividend by the firſt of the Diviſor, then the partial Dividend will conſiſt of as many Places as the Diviſor, otherwiſe 'twill conſiſt of one Place more.

N. B. Second, If at any Step the Remainder is equal to or exceeds the Diviſor; then the quote Figure is too little, and muſt be increas'd.

Examp. thus Quote
467) 396478 (848
2287
4198
Remains 462

N. B. In the latter Example I have only put down the Remainders; nor is there ever any neceſſity to put down the Subtractors.

To prove Diviſion by expunging the 9's.

Rule.

Reject the 9's in Diviſor and Quote (ſeverally) and alſo in the Product of theſe Remainders; then if the remaining Figure be equal to the remaining Figure of the Difference of the Dividend, and its Remainder, (after the 9's are expung'd out of ſaid Difference) the Work is right, otherwiſe not.

N. B. This Method of proving theſe 4 Rules is fallible; for tho' it will not make the Work appear to be wrong when it is right, it will ſometimes make it appear to be right when it is wrong.

The Reaſon is this, the 9's being expunged out of 848 or 488 or 884, the Remainders are the ſame in every Caſe, though no two of theſe (Quotes or) Numbers are of equal Value: Therefore the only certain way of proving theſe Rules, is generally thought to be by their Contraries; *viz.* Addition by Subtraction; Subtraction by Addition;

Multiplication by Diviſion; and Diviſion by Multiplication.

But theſe Methods are very tedious; neither are they infallible: And each Rule may be as certainly prov'd by itſelf, as I ſhall ſhew in its proper Place.

THE USE OF ADDITION.

How to add different Denominations (of any kind) by one general

RULE.

ADD up the firſt right-hand Column, and find how many Units of the Denomination of the next Column are contain'd in the Sum; put down the Remainder under the added Column, and carry the Units to the next Column; and ſo proceed thro' all the Columns.

N. B. The higheſt Denominations given, are always added as in plain Addition, carrying 1 for every Ten.

	l.	*s.*	*d.*	
Examp. Borrow'd	416	16	4½	How much am I in Debt?
Again	304	15	6¼	
At another time	76	13	9¾	
Anſwer	798	5	8½	

To prove Addition by Addition.

RULE.

Find the Sum of any Number of the given Lines, and alſo the Sum of the remaining Lines; then the Total of theſe Sums muſt be equal to the Total of the given Sums.

Proof of the foregoing Queſtions.

	l.	*s.*	*d.*	
	416	16	4½	
	304	15	6¼	
	721	11	10¾	
	76	13	9¾	
Sum	798	5	8½	as bef.

4971	1	13
2005	0	10
6976	1	23

Proof.				
	3640	2	26½	
	6739	3	20½	
	10380	2	19	
	6976	1	23	
Tot.	17357	0	14	as bef.

	Ct.	qrs.	℔.
Add	3640	2	26½
	6739	3	20½
	4971	1	13
	2005	0	10
Total	17357	0	14

Or this Rule may be prov'd by Subtraction, *viz.* by ſubtracting the added Lines ſeverally from the Total.

Troy Weight.

℔.	oz.	dw.	gr.
42	11	19	23
36	9	17	20
97	10	15	16

Apothecaries Weight.

℔.	oz.	dm.	ſeq.	gr.
36	11	7	2	19
27	10	3	0	12
14	9	0	1	16

Wine Meaſure.

T.	hhd.	gal.
15	3	62
19	2	60½
13	0	7¼

Cloth Meaſure.

Yds.	qrs.	r.
90	3	3½
46	0	2½
37	2	1¾

Time.

Yea.	da.	ho.	m.	ſ.
40	364	23	59	59
25	300	20	36	40
86	109	15	30	11
47	130	10	21	10

Long Meaſure.

m.	f.	p.	y.	q.	i.	b.
50	7	39	5	2	11	2
10	3	30	2	1	6	1
11	0	20	0½	0	10	0

THE USE OF SUBTRACTION.

To ſubtract different Denominations.

GENERAL RULE.

BEGIN with the loweſt Denomination given, and if the under Number is leſs than the upper, put down the Difference; but if it is greater, add as many Units (of the ſame Denomination) to the upper as are equal to an Unit of the next higher (given) Denomination, and carry 1 to the under Number of ſaid next higher Denomination; and ſo proceed through all, ſubtracting the higheſt Denomination as in whole Numbers.

Examp.

		l.	*s.*	*d.*	
Examp.	Borrow'd	46	13	6½	How much
	Paid	23	19	4¾	is due?
		22	14	1¾	

How to prove this Rule by Subtraction.

RULE.

From the Subtrahend take the Difference found; this Remainder muſt be equal to the given Subtractor. Or it may be prov'd by Addition. Thus, the Sum of the Remainder and Subtractor, is equal to the given Subtrahend.

Proof by Subtraction.

	46	13	6½
	22	14	1¾
Subtractor	23	19	4¾

Proof by Addition.

	23	19	4¾
	22	14	1¾
Subtrahend	46	13	6½

Avoirdupoiſe.

	Ct.	qr.	℔.
From	15	3	27
Take	7	2	16¼

Troy Weight.

	℔.	oz.	dw.	gr.
Bought	31	11	12	16
Sold	9	4	16	19

Apothecary's Weight.

	℔.	oz.	dw.	ſeq.	gr.
Rec.	13	5	6	0	14
Deliv.	10	6	3	2	12

Liquid Meaſure.

T.	hhd.	gal.
30	2	60
15	0	62½

Long Meaſure.

m.	f.	p.	f.
41	4	30	14
20	5	36	7

Cloth Meaſure.

Ells.	yds.	n.
30	4	2
20	3	3½

Time.

Years.	Days.	h.	m.
20	300	20	40
19	106	21	50

THE USE OF MULTIPLICATION.

How to multiply different Denominations by any Digit.

A GENERAL RULE.

MULTIPLY the Number in the loweſt Denomination by the given Digit, find how many Units of the next higher (given) Denomination are contain'd in ſaid Product, put down the Remainder, and carry the Units to the next Product; and ſo proceed.

Examp. Bought 6 Yards of Velvet at 2 *l.* 10 *s.* 6 *s.* *per* Yard. What is the Amount?

	l.	*s.*	*d.*
	2	10	6
			6
Anſwer.	15	3	0

	l.	*s.*	*d.*
	36	16	9½
			×10
Anſ.	368	7	11

What coſt 36½ Gallons, at 5 *s.* 6 *d.* *per* Gallon?

1. In 400 *l.* how many Farthings?

2. In 36 *l.* 16 *s.* 6 *d.* ½, how many Farthings?

3. In 207 Guineas (of 21 *s.* each) how many Pence?

4. In 35 Moidores, and 2 Crowns, how many ½ Pence?

5. In 960 Millreas of 6 *s.* 6 *d.* each, how many Pence?

6. In 360 *French* Crowns of 4 *s.* 6 *d.* how many Pence?

7. In 30 Bags, each Bag containing 30 Purſes, each Purſe 30 Crowns, each Crown 5 *s.* 5 *d.* how many ½ Farthings?

8. In 56 C. 3 qrs. 26 ℔. ½, how many Ounces?

9. In 32¾ Yards, how many Nails?

10. In 42 Ells *Engliſh*, how many Nails?

11. In 42 Ells *Flemiſh*, how many ½ Nails?

12. How many Pounds are there in 20 Caſks, each 3 C. 2 qrs. 17 ℔?

13. How many Gallons in 24 Tun, 3 Hogſheads, 40 Gallons?

14. If 1 Yard (ſquare) of Land is worth 1 Penny, what is 1 Acre worth?

15. How many Barley-corns would reach from *London* to *Briſtol*, ſuppoſing the Diſtance 110 *Engliſh* Miles?

16. How many Inches is the Earth in Circumference, ſuppoſing it 360 Degrees, and each Degree 69½ Miles?

17. How many Minutes are there in a tropical Year, allowing it to conſiſt of 365 Days, 5 Hours, 49 Minutes?

18. How many Seconds are there in a ſidereal Year, conſiſting of 365 Days, 6 Hours, 9 Minutes, 14 Seconds?

THE

THE USE OF DIVISION.

How to divide different Denominations by an Integer (or any Number not exceeding 12.*)*

RULE.

PUT down the Quote of the integral Part, under the higheſt Denomination; what remains, reduce to the next inferior (given) Denomination, adding thereto the given Number of ſaid Denomination; divide the Sum by the given Diviſor, and put the Sum under ſaid Denomination, and ſo proceed.

1. Examp. If 6 Yards of Velvet coſt 15 *l.* 3 *s.* what is that *per* Yard?

l. *s.*
6) 15 3

Anſwer 2 10 6

2. If 10 Hogſheads of Wine coſt 368 *l.* 7 *s.* 11 *d.* what is that *per* Gallon?

10) 368 7 11

9) 36 16 $9\frac{1}{2}$ the Price of 1 Hhd.

7) 4 1 $10\frac{7}{8}$

Anſwer 0 11 $8\frac{43}{126}$ or 11 *s.* 8 *d.* $\frac{3}{4}$ nearly.

1. In 384000 Farthings, how many *L.* ſterling?
2. In 35354 Farthings, how many *L.* ſterling?
3. In 52164 Pence, how many Guineas?
4. In 22920 Half-pence, how many Moidores?
5. In 37440 Pence, how many Millreas of 6 *s.* 6 *d.*?
6. In 9720 Pence, how many *French* Crowns of 4 *s.* 6 *d.*?

7. In 1755000 Pence, how many Crowns of 5 *s.* 5 *d.* each, and Purſes of 30 Crowns each, and Bags of 30 Purſes each?

8. In 102120 Ounces, how many C. &c?

9. In 524 Nails, how many Yards?

10. In 840 Nails, how many Ells *Engliſh*?

11. In 1008 Half-nails, how many Ells *Flemiſh*?

12. In 8180 ℔. how many Caſks of 3 C. 2 q. 17 ℔. each?

13. In 6277 Gallons, how many Tun, &c?

14. If 4 *l.* 13 *s.* 4 *d.* is paid for 1 Acre of Land, what is a ſquare Yard worth, allowing 7 ſquare Yards to a ſquare Perch?

15. Suppoſe the Diſtance between *London* and *Briſtol* to be 20908800 Barley-corns, how many *Engliſh* Miles are theſe two Cities aſunder?

16. If the Earth is 1585267200 Inches in Circumference, how many *Engliſh* Miles is it?

17. If a tropical Year conſiſts of 525900 Minutes, how many Days, &c. are therein?

18. What is the Difference in Hours, &c. betwixt a tropical and a ſidereal Year, the latter containing 3155217 Seconds?

19. At a Crown a Yard, how many Yards can I buy for 21 Guineas and 27 Moidores? Anſwer 234.

20. If I ſpend 10 *s.* 6 *d.* *per* Week, what are my annual Expences? Anſwer 27 *l.* 6 *s.*

21. 27 *l.* 7 *s.* 6 *d.* *per Annum*, what is that *per* Day? Anſwer 18 *d.*

22. Divide 2 *l.* 12 *s.* 6 *d.* among 7 Men and a Boy, giving the Boy half as much as a Man. Anſwer, the Boy muſt have 3 *s.* 6 *d.* and a Man 7 *s.*

23. Divide 3 *l.* 2 *s.* 6 *d.* amongſt 8 Women and a Man, giving the Man as much as 2 Women. Anſwer, the Man muſt have 12 *s.* 6 *d.* and each Woman 6 *s.* 3 *d.*

24. A Gentleman employs in his Garden 8 Men, 5 Women, and 3 Boys, for 24 Days; and being deſirous to try his Steward's Skill in Figures, gives

him 47 *l.* and a Crown to pay them all; telling him, that his Agreement was to pay each Woman half as much as a Man, and each Boy half as much as a Woman; at what Rate *per* Day was each Perſon paid? Anſwer, a Man 3 *s.* 6 *d.* a Woman 1 *s.* 9 *d.* and a Boy 10 *d.* $\frac{1}{2}$.

THE RULE OF THREE DIRECT.

IN this Rule are always given three Numbers to find a fourth, that ſhall bear ſuch Proportion to the third, as the ſecond does to the firſt; and conſequently, as the firſt to the ſecond, ſo is the third to the fourth.

Definition of Proportion.

By Proportion, is meant the Quote of the Conſequent divided by the Antecedent.

Note, the Number compared is call'd the Antecedent; and the Number which the Antecedent is compared to, is called the Conſequent. Examp. As 2 is to 6, ſo is ſome other Number to a fourth Number.

Here, 2 is the Antecedent, and 6 is the Conſequent; and the Ratio of 2 to 6 is $\frac{6}{2} = 3$.

Therefore, ſince the ſecond Term is triple the firſt, whatever Number we aſſume for the third, the fourth Number (ſought) muſt be triple that third Number, (as 2 : 6 :: 5 : 15 — or 2 : 6 :: 10 : 30). Again, as 6 to 2, ſo is ſome other Number to a fourth Number: Here 6 is the Antecedent, and 2 is the Conſequent, and the Ratio of 6 to 2 is $\frac{2}{6} = \frac{1}{3}$.

And ſince the ſecond Term is equal to one third of the firſt; therefore whatever Number is given for the third, the fourth Number (ſought) muſt be equal to one-third of that Number.

Thus 6 : 2 :: 15 : 5 or as 6 : 2 :: 30 : 10
Or as 6 : 2 :: 13 : $4\frac{1}{3}$, &c.

Univerſally.—Make the ſecond Number the Numerator of a Fraction, whoſe Denominator is the firſt Term: And make the fourth Number the Numerator of another Fraction, whoſe Denominator is the third Number; then if theſe two Fractions are equal, the firſt Number will bear the ſame Proportion to the ſecond as the third doth to the fourth. And ſo we find

$$\frac{6}{2} = \frac{15}{5} = \frac{30}{10}; \text{ and } \frac{2}{6} = \frac{5}{15} = \frac{10}{30} = \frac{4\frac{1}{3}}{13}, \text{ \&c.}$$

Having three Numbers given, to find a fourth.

1ſt, To ſtate the Queſtion.

RULE.

Your third Number is always that which (in the Propoſition) moves the Queſtion; and the firſt is of the ſame Kind with the third: conſequently, ſince one of the three given Terms is always of the ſame Kind with the Term ſought, that muſt be the middle Term.

2d, To work the Stating.

RULE.

Reduce your firſt and third Terms to one Denomination (your middle Term may, or may not be reduc'd) and then the Product of your ſecond and third, divided by the firſt Term, quotes the fourth, in the ſame Denomination with the middle Term.

Examp. What coſt 6 Yards of Cloth, if 4 Yards coſt 12 *s*?

Here the Demand lies on the 6 Yards, therefore that muſt be the third Term; and the Term of the ſame Kind with 6 Yards, is 4 Yards, therefore 4 Yards is the firſt Term: Hence the Stating is thus;

$$\begin{array}{rcccc} & \text{Yds.} & s. & & \text{Yds.} \\ \textit{viz.} & 4 & : 12 & :: & 6 \\ & & \times 6 & & \\ \hline & 4\ ) & 72 & & \\ \hline \end{array}$$

Anſwer 18 *s*.

Or from the following Conſideration, we may deduce a more ſimple Rule, *viz.*

There are always two of the three given Terms of one Kind, and another of a different Kind (which being ſingle in its Species) we may call the given ſingle Term: thus (in the foregoing) ſince 4 and 6 do both repreſent Cloth, they are the two Terms of one kind; and becauſe the Number 12 repreſents Money, (different from the other two Terms) it is the given ſingle Term. Next we are to conſider which of the other two Terms is the Correſpondent of the ſingle Term, but that is evidently the Term 4; for 4 Yards are equal in Value to 12 *s.* therefore 4 is the Relative of the given ſingle Term: and thus by the Relative of the given ſingle Term we ſhall always underſtand its Equal in Value, or its reciprocal Term; for theſe two Terms reciprocally produce each other.

RULE.

Reduce the two given Terms of like Species to one Denomination, and always make the Relative of the given ſingle Term, the firſt Term (or Diviſor); the Product of the other two Terms divided by the firſt, quotes the fourth, in the ſame Denomination with the given ſingle Term.

And the Advantage of this Rule is, that if we put the right Term in the firſt Place, 'tis of no conſequence in what Order the other two Terms are placed (as to ſecond or third).

And if we pleaſe, we may reject the Stating, and all regard thereto—for we may expreſs it thus.

RULE.

The two Terms of like kind being reduc'd to one Denomination, take the Relative of the ſingle Term for a Diviſor to the Product of the other two Terms; the Quote is the fourth Term, in the ſame Denomination with the given ſingle Term.

Example. If 6 *l.* Intereſt is gain'd by 100 *l.* in a certain time, what Intereſt will 560 *l.* gain in the ſame time at the ſame Rate?

Here 100 *l.* and 560 *l.* are both Principals, therefore they are the two Terms of like kind; and 6 *l.* is of a different kind from both, for it is Intereſt; therefore 6 *l.* is the given ſingle Term, and 100 *l.* is its Relative; (the 6 *l.* being produc'd by the 100 *l.* Principal) therefore the fourth Term is found by multiplying 560 by 6, and dividing the Product by 100.

The Work.

```
          560
            6
        -------
100 ) 33 | 60
         |  20
        -------
      12 | 00     Anſwer 33 l. 12 s.
         ---
```

Example 3d, If 19 C. 3 q. 20 ℔. coſt 4 *l.* 3 *s.* what Quantity can I buy for 3 *l.* 3 *s?*

Here, 'tis plain at firſt ſight that 19 C. 3 q. 20 ℔. is the given ſingle Term, and that 4 *l.* 3 *s.* is its Relative; which is therefore the firſt Term.

```
l.  s.    l.  s.      C.    q.  ℔.
4   3  :  3   3  ::   19    3   20
20        20                    ×9
——        ——        ——————————————
83        63          178   1   24
                                ×7
                  ——————————————————
             83 ) 1249   1 ( 15C. 0q. 5℔. + 34 ℔
                  1419
                     4
                   112
                  ————
                  ) 449
                    34 remains.
```

I ſhall in ſome of the following Queſtions put this Mark * to the Relative of the given ſingle Term, which being known to be the firſt Term or Diviſor, the Learner cannot poſſibly ſtate the Queſtion wrong, ſince there is no particular Order neceſſary for the other two Terms.

1. What coſt 30 Yards at 16 *s.* 6 *d.* for 1 * Yard?
2. If 30 * Yards coſt 24 *l.* 15 *s.* what coſt 1 Yard?
3. If 30 Yards coſt 24 *l.* * 15 *s.* what Quantity can I buy for 16 *s.* 6 *d?*
4. What Quantity can I buy for 24 *l.* 15 *s.* at the Rate of 16 *s.* * 6 *d. per* Yard?
5. If 30½ Yards coſt 25 *l.* * 4 *s.* 6 *d.* ¼, what Quantity can I buy for 16 *s.* 6 *d.* ½?
6. At 16 *s.* * 6 *d.* ½ *per* Yard, what Quantity can I buy for 25 *l.* 4 *s.* 6 *d.* ¼?
7. If 25 *l.* 4 *s.* 6 *d.* ¼ is paid for 30 * ½ Yards, what is that *per* Yard?

8.

8. If 1 * Yard coſt 16 *s.* 6 *d.* ½, what coſt 30 ½ Yards?

9. At 15 *l.* * 10 *s.* 6 *d.* *per* Hhd. what Quantity can I buy for 163 *l.* 0 *s.* 3 *d*?

10. At 163 *l.* * 0 *s.* 3 *d.* for 10 ½ Hhds. what Quantity can I buy for 15 *l.* 10 *s.* 6 *d*?

11. If 10 * ½ Hhds. coſt 163 *l.* 0 *s.* 3 *d.* what coſt 1 Hhd?

12. If 1 * Hhd coſt 15 *l.* 10 *s.* 6 *d.* what is the Amount of 10 ½ Hhds?

13. What coſt 1 C. of Indigo, at 6 *s.* 6 *d.* *per* ℔?

14. If I pay 36 *l.* 8 *s.* *per* C. for Indigo, what is that *per* ℔?

15. At 6 *s.* 6 *d.* *per* ℔. what Quantity can I buy for 36 *l.* 8 *s*?

16. If 1 C. coſt 36 *l.* 8 *s.* what Quantity can I buy for 6 *s.* 6 *d*?

17. What will 5 C. 3 q. 20 ℔. of Tea come to at 9 *d.* ½ *per* oz?

18. At 9 *d.* ½ *per* oz. what Quantity can I buy for 420 *l.* 10 *s.* 8 *d*?

19. At 12 *s.* 8 *d.* *per* ℔. what Quantity can I buy for 420 *l.* 10 *s.* 8 *d*?

20. At what Rate *per* ℔. do I buy Tea, if I pay 240 *l.* 10 *s.* 8 *d.* for 5 C. 3 q. 20 ℔?

21. If 21 ℔. of Sugar coſt 14 *s.* 10 *d.* ¼, what Quantity can I buy for 7 *l.* 8 *s.* 9 *d*? Anſwer 1 C. 3 q. 14 ℔.

22. What coſt 10 Pieces and 5 Yards of Stuff, each Piece containing 25 ½ Yards, at 30 *s.* 3 *d.* for 5 ½ Yards? Anſwer 71 *l.* 10 *s.*

23. Requir'd the Amount of 208 Ells *Engliſh* at the above Rate. Anſwer, as above.

24. Requir'd the Amount of 346 ⅔ Ells *Flemiſh*, at 6 *s.* 10 *d.* ½ *per* Ell *Engliſh*. Anſwer, as above.

25. Shipp'd off 360 Caſks of Butter, each containing 1 C. 3 q. 14 ℔. bought at 28 *s.* *per* C. paid for Duty 4 *d.* *per* C. for Cellarige 3 *s.* 6 *d.* for Porterage and Boat-hire 5 *l.* 5 *s.* Now if I pay for

Freight 20 *l.* and allow my Factor for his Trouble 9 *l.* 9 *s.* I demand how he muſt ſell it *per* Caſk to gain me double the Coſt and Charges wanting 62 *l.* and how his Commiſſion is rated *per* C? Anſwer, he muſt ſell at 7 *l.* 17 *s.* 6 *d.* and his Commiſſion is rated at ½ *per Cent.* that is, he has 10 *s.* out of every 100 *l.* Sale.

26. What Rate *per* ℔. was the above Butter bought and ſold at? Anſwer, it was bought at 3 *d.* *per* ℔. and ſold at 9 *d.*

27. Bought 3 Sorts of Wine, and of each an equal Quantity, *viz.* at 6 *s.* 6 *d.* at 7 *s.* and at 8 *s.* 6 *d.* *per* Gallon, the whole amounting to 101 *l.* 11 *s.* and 26 Milrees of 6 *s.* 6 *d.* each, I demand the Quantity of each Sort. Anſwer, 100 Gallons.

28. What does the foreſaid Wines ſtand me *per* Gallon, one with another? Anſwer, 7 *s.* 4 *d.*

29. Bought 5 four-gallon Caſks of Rum at 10 *s.* 6 *d.* *per* Gallon; how much Water muſt I mix with ſaid Liquor, to gain the prime Coſt of 1 Gallon, by ſelling the Mixture at 6 *s.* *per* Gallon?

30. If with 20 Gallons of Rum I mix 16 ¾ Gallons of Water, and by ſelling the Mixture at 6 *s.* *per* Gallon, find to have gain'd 10 *s.* 6 *d.* by the whole, I demand the prime Coſt of a Gallon of Rum?

31. Sold 63 ¾ Gallons of Rum and Water, by which I find to have gain'd 10 *s.* 6 *d.* this being the prime Coſt of a Gallon of Rum, requir'd the Quantities of Rum and Water (ſeverally) in the Mixture?

32. Sold 36 ¾ Gallons of Rum and Water for 11 *l.* 0 *s.* 6 *d.* there being 20 Gallons of pure Rum in the Mixture, at 10 *s.* 6 *d.* *per* Gallon, I demand the total Gain, and how the Mixture was ſold *per* Gallon?

33. Bought 100 Yards of Velvet for 150 *l.* which I ſold at 10 Ducats *per* Ell *Engliſh*, and find to have

gain'd 30 *l.* I demand the ſterling Value of a Ducat? Anſwer, 4 *s.* 6 *d.*

34. Sold 60 Yards of Cloth for 40 *l.* by which I find to have gain'd $\frac{1}{3}$ of the prime Coſt, I demand what that was *per* Yard? Anſwer, 10 *s.*

35. Sold 90 Yards for 45 *l.* and find to have gained the prime Coſt of 9 Yards, I demand what that was? Anſwer, 4 *l.* 1 *s.* 9 *d.* $\frac{1}{55}$.

36. Bought a Parcel of Cloth at the Rate of 16 *s.* 6 *d.* for every 3 Yards, of which I ſold 5 equal Pieces at the Rate of 20 *s.* for 2 $\frac{2}{3}$ Yards, and thereby find to have gain'd as much as 20 Yards did coſt, I demand the Length of each Piece? Anſ. 11 Yards.

PRACTICE.

DEFINITION.

BY Practice is commonly underſtood ſuch Queſtions of the Rule of Three, whoſe firſt Term (when ſtated) is an Unit of the higheſt Denomination given in the third Term (when mixt). But if the firſt be any Number of Units, or a mixt Number, then this Queſtion is not conſider'd as belonging to the Rule of Practice.

Note, If 'tis a Fraction, it may (by increaſing the Price) be reduc'd to an Integer: Hence, Practice is only a Contraction of Multiplication, by ſeveral Diviſions. — And conſequently, (though all Queſtions of Practice may be ſolv'd by the Rule of Three, yet) all Queſtions of the Rule of Three cannot be ſolv'd by Practice, which renders this Rule very limited in its Application.

A GENERAL RULE.

Take Parts for every inferior Denomination out of the next higher, or take Parts for every ſucceeding

Factor out of ſome of the preceding, or out of the higheſt Denomination; always obſerving to take your Parts out of the Reſult belonging to that Factor, which you have us'd as Multiple to your preſent Factor.

And then take Parts for the odd Weight or Meaſure, *&c.* out of the given Price: the Sum of all theſe Reſults is the total Price ſought.

1. What coſt 360 Yards at 10 *s*?
10 *s*. = $\frac{1}{2}$ ——
180 *l*. Anſwer.

2. What coſt 360 at 15 *s*?

10 *s*. = $\frac{1}{2}$ = 180 Price at 10 *s*.
5 *s*. = $\frac{1}{2}$ = 90 Price at 5 *s*.

Anſwer 270 Price at 15 *s*.

3. 360 at 17 *s*. 6 *d*?

10 = $\frac{1}{2}$ = 180
5 = $\frac{1}{2}$ = 90
2.6 = $\frac{1}{2}$ = 45

Anſwer 315 *l*.

4. 360 at 6 *d*?

6 *d*. = $\frac{1}{2}$ = 180 *s*. = 9 *l*. Anſwer.

5. 360 at 9 *d*?

6 *d*. = $\frac{1}{2}$ = 180
3 *d*. = $\frac{1}{2}$ = 90

Anſwer 270 *s*. = 13 *l*. 10 *s*.

6. What coſt 360 Yards at 10 *d*?

6 *d*. = $\frac{1}{2}$ = 180
4 *d*. = $\frac{1}{3}$ = 120

Anſwer 300 *s*. = 15 *l*.

7. 360 at 11 *d*?

6 = $\frac{1}{2}$ = 180
3 = $\frac{1}{2}$ = 90
2 = $\frac{1}{3}$ = 60

Anſwer 330 *s*. = 16 *l*. 10 *s*.

Or thus:

7. 360

$$\left.\begin{array}{l} 6 = \frac{1}{2} = 180 \\ 4 = \frac{1}{3} = 120 \\ 1 = \frac{1}{4} = 30 \end{array}\right\} 330\,s. = 16\,l.\ 10\,s.$$

8. 360 C. 3 q. at 18 *s*. 5 *d*?

10 *s*. = $\frac{1}{2}$ = 180
5 = $\frac{1}{2}$ = 90
2.6 = $\frac{1}{2}$ = 45
10 = $\frac{1}{3}$ = 15
1 = $\frac{1}{10}$ = 1 10

2 q. = $\frac{1}{2}$ C. 0 9 $2\frac{1}{2}$ = $\frac{1}{2}$ of 18 *s*. 5 *d*.
1 q. = $\frac{1}{2}$ 0 4 $7\frac{1}{4}$

Anſwer 227 3 $9\frac{3}{4}$

9. 360 C. 3 q. 14 ℔. at 18 *s*. 5 *d*?

To the above add the Price of 14 ℔. *viz*. $\frac{1}{2}$ of 4 *s*. 7 *d*. $\frac{1}{4}$ = 2 . 3 $\frac{3}{4}$. Anſwer 227 *l*. 6 *s*. 1 *d*. $\frac{1}{2}$.

10.

10. What coſt 360 C. 3 q. 21 ℔. at 6 *l.* 18 *s.* 5 *d*?

	360		
	6		
	2160		
10 *s.* = ½ =	180		
5 = ½ =	90		
3 4 *d.* ⅙ =	60		
1 1/40 =	1	10 *s.*	
2 q. ½	3	9	2¼
1 ½	1	14	7¼
7 ℔. ½		17	3½ or ⅝ exact.
Anſwer	2497	11	1¼

11. What coſt ¼ C. at 6 *l.* 18 *s.* 6 *d*? Anſwer, 1 *l.* 14 *s.* 7 *d.* ½.

12. ¾ C. at 6 *l.* 18 *s.* 6 *d*? Anſwer 5 *l.* 3 *s.* 10 *d.* ½.
13. ½ C. at 6 18 6? 3 9 3.
14. 14 ℔. at 6 18 6? 17 3¾.
15. 16 at 6 18 6? 18 7¾.
16. 7 at 6 18 6? 8 7¾.
17. 360 at 10 *s*? Anſwer 180 *l.*
18. 360 at 15? 270.
19. 360 at 17 6 *d*? 315.
20. 360 at 6? 9.
21. 360 at 3? 4 10 *s.*
22. 360 at 9? 13 10.
23. 360 at 4? 6.
24. 360 at 8? 12.
25. 360 at 11? 16 10.
26. 360 at 6 *l.* 18 *s.* 6 *d*? Anſwer 2493 *l.*

27. 360 C. 1 q. at 6 *l.* 18 *s.* 6 *d*? Anſw. 2494 *l.* 14 *s.* 7 *d.* ½.

28. 360 C. 3 q. at 6 *l.* 18 *s.* 6 *d*? Anſw. 2498 *l.* 3 *s.* 10 *d.* ½.

29. 360 C. 3 q. 14 ℔. at 6 *l.* 18 *s.* 6 *d*? Anſwer 2499 *l.* 1 *s.* 2 *d.* ¼.

30. What coſt 360 C. 3 q. 16 ℔. at 6 *l.* 18 *s.* 6 *d*? Anſwer 2499 *l.* 2 *s.* 6 *d.* ¼.

31. 360 C. 3 q. 23 ℔. at 6 *l.* 18 *s.* 6 *d*? Anſw. 2499 *l.* 11 *s.* 2 *d.*

32. 360 C. at ¼ *per* Yard? Anſwer 0 *l.* 7 *s.* 6 *d.*

33. 9⅞ at 12 *s.* 6 *d.* ½? 6 3 10.

34. 21 ℔. ½ at 10 *s.* 9 *d.* ½ *per* ½ C? Anſwer 4 *s.* 1 *d.* ½.

35. 21 ℔. ½ at 10 *s.* 9 *d.* ½ *per* ¼ qr? Anſwer 8 *s.* 3 *d.* ½.

36. 36 dozen Pair of Stockings at 4 *s.* 6 *d.* ½ *per* Pair? Anſwer 98 *l.* 2 *s.*

37. What coſt ½ a Dozen at the Rate of 7 *l.* 16 *s.* the great Groſs? Anſwer 6 *d.* ½.

38. If ⅔ Oz. coſt 3 *s.* 6 *d.* what coſt 1 ℔. Troy? Anſwer 3 *l.* 3 *s.*

39. What coſt 5 C. 2 q. 20 ℔. at the Rate of 6 *l.* 15 *s.* 9 *d.* for 3 qrs? Anſwer 51 *l.* 7 *s.* 9 *d.* ¾.

40. What ſterling Money muſt be paid for a Bill of Exchange, drawn for 436 ½ Pieces, at 9 *s.* 11 *d.* ¾ *per* Piece? Anſwer 217 *l.* 15 *s.* 11 *d.* ½.

Note, This may be work'd by ſix Figures.

41. Requir'd the Amount of 5 T. 3 Hhds. 9 Gal. of Wine-meaſure, at 16 *l.* 15 *s.* 9 *d.* *per* Ton. Anſwer 97 *l.* 2 *s.* 6 *d.* ½.

42. What coſt 20 T. 19 C. 3 q. 27 ℔. ¾, at the Rate of 20 *l.* 19 *s.* 11 *d.* ¾ *per* Ton? Anſwer 713 *l.* 19 *s.* 1 *d.* 1 q. $\frac{1}{2240}$.

TARE AND TRET, &c.

Perform'd by Practice, or the Rule of Three.

DEFINITION.

1ſt. GROSS is the Weight of the Commodity, and that wherein it is contain'd, as Box, Bag, Cheſt, &c. incluſively.

2d. Tare is the Weight of the Bag or Box, *&c.* to be ſubtracted from the groſs Weight, which leaves the Weight of the Commodity.

3d. Tret is an Allowance of 4 ℔. for every 104 ℔. or 1 ℔. for every 26 ℔. that remains, after the Tare is deducted.

4th. Subtile is the Weight of the Commodity (the Tare being deducted from the Groſs) from which the Tret is to be ſubtracted.

5th. Cloff is an Allowance of 2 ℔. upon every Draught of 300 ℔. and upwards in the Groſs, allow'd for the Turn of the Scale.

6th. Neat is the Weight to be paid for all Allowances being deducted.

Examp. What is the neat Weight of the 3 following Bags of Raiſins, Tare at 30 ℔. *per* Bag, and Tret 4 ℔. for every 104 ℔. Cloff 2 ℔. for every 300 ℔. after the Tret is deducted?

Weights.

Caſks.	C.	q.	℔.	
In A - -	9	3	0	
B - -	6	2	20	
C - -	18	0	21	
Total groſs Weight =	34	2	13	℔.
Tare =		3	6	= 90 = 3 × 30.
26)	33	3	7	Subtle.
Tret	1	1	5½	nearly
150)	32	2	1½	
Cloff =			24½	nearly.
Anſwer neat	32	1	5	

Bought 36 C. 3 q. 18 ℔. at 15 *s. per* C. neat; now if the Tare is allow'd at the Rate of 16 ℔. *per*

C. and Tret at 4 ℔. for 104; I demand the Amount.

C. q. ℔.
7) 36 3 14 Groſs.
5 1 2 Tare.

26) 31 2 12 Subtle.
1 0 24 Tret.

30 1 16

10*s*. = ½ = 15
5 = ½ = 7 10

1 q. = ¼ = 3 9 *d.*
16 ℔. = ⅐ = 2 1¾ near.

Anſwer 22 15 10¾ = the Amount ſought.

SIMPLE INTEREST.

Rule 1ſt.

As any Principal to its Intereſt, ſo is any other Principal to its Intereſt, for the ſame Time, at the ſame Rate.

Examp. What is the Intereſt of 300 *l.* for 1 Year, at 5 *l. per Cent. per Annum?*

P.	In.	P.
100	5	300
		× 5

100) 15 | 00 Anſwer 15 *l.*

Hence, ſince to divide by 100 is only to cut off two right-hand Figures in the Dividend.

The Rule may be expreſs'd thus:

RULE 2d.

Multiply the given Principal by the Rate, and cut off two right-hand Figures in the Product, the left-hand Figures are the Intereſt of the given Principal (if the Figures cut off are 0 or inſignificant) for 1 Year, which multiply'd by the given Time, gives the Intereſt for ſaid Time.

Or thus:

RULE 3d.

Multiply the given Principal by the Product of the Rate and Time; cut off two right-hand Figures in the Product, and reducing theſe two Figures (cut off) into the next inferior Denomination; cut off two Figures, and ſo proceed till the laſt Denomination is Farthings; then the left-hand Figures in the ſeveral Denominations are the Intereſt ſought.

2. Requir'd the Intereſt of 1000 *l.* at 10 *per Cent. per Annum.*

Anſwer 100 | 0.

3. Requir'd the Intereſt of 372 *l.* at 4 *per Cent.*

4

14 | 88

20

17 | 60

12

Anſ. 14 *l.* 17 *s.* 7 *d.* ⅕

7 | 20

1|0|0 ⅕ *d.*

4.

l. *s.* *d.*

4. Requir'd the Intereſt of 36 16 6 at 3 *per Cent.*

3

1 | 10 9 6

20

2 | 90

12

Anſwer 1 *l.* 2 *s.* 1 *d.* $\frac{7}{50}$

1 | 14

4

| 56 no Farthings.

l. *s.* *d.*

5. Requir'd the Intereſt of 360 19 $11\frac{1}{2}$ at $4\frac{1}{2}$ *per Cent.*

$4\frac{1}{2}$

1343 19 10 =

180 9 $11\frac{3}{4}$

15 | 24 9 $9\frac{3}{4}$

20

4 | 89

12

Anſ. 15 *l.* 4 *s.* 10 *d.* $\frac{3}{4}$.

10 | 77

4

3 | 11 remains.

l. s. d.
6. Requir'd the Intereſt of 360 19 11 at ¼ *per Cent.*
4) ————
90 4 11¼
20
————
18 | 04
12
Anſwer 18 *s.* 0 *d.* ½ near.
————
0 | 59
4
————
2 | 39

QUESTIONS.

7. Requir'd the Intereſt of 1683 *l.* 6 *s.* 8 *d.* for 1 Year at ¼ *per Cent. per Annum?* Anſwer 4 *l.* 4 *s.* 2 *d.*

8. Requir'd the Intereſt of the above Principal for 1 Year, at ½ *per Cent?* Anſwer 8 *l.* 8 *s.* 4 *d.*

9. Ditto, at ¾ *per Cent?* Anſwer 12 *l.* 12 *s.* 6 *d.*
10. At 1 *per Cent?* Anſwer 16 *l.* 16 *s.* 8 *d.*
11. At 4 *per Cent?* 67 6 8.
12. At 5¼ *per Cent?* 88 7 6.
13. At 5½ *per Cent?* 92 11 8.
14. At 5¾ *per Cent?* 96 15 10.

15. Requir'd the Intereſt of 1683 *l.* 6 *s.* 8 *d.* for ¼ of a Year, at 1 *per Cent. per Annum?* Anſwer 4 *l.* 4 *s.* 2 *d.*

N. B. And thus, if we call the Rate, the Time, and the Time the Rate, all the Anſwers will be the ſame as above.

16. Requir'd the Intereſt of 372 *l.* for 3 Years, at 4 *per Cent?* Anſwer 44 *l.* 12 *s.* 9 *d.* ⅗.

17. Requir'd the Intereſt of 372 *l.* 15 *s.* 10 *d.* for 2½ Years, at 4 *per Cent. per Annum?* Anſwer 37 *l.* 5 *s.* 7 *d.*

18. Requir'd the Intereſt of 372 *l.* 15 *s.* 10 *d.* for 4 Years, at 7½ *per Cent?* Anſwer 111 *l.* 16 *s.* 9 *d.*

19. Requir'd the Intereſt of 372 *l.* 15 *s.* 10 *d.* for 4 Years, at 25 *per Cent.* or for 25 Years at 4 *per Cent?* Anſwer 372 *l.* 15 *s.* 10 *d.*

To find the Intereſt for any Number of Days.

RULE.

As 365 (the Days in a Year) to the given Number of Days, ſo is the Intereſt of the given Principal for 1 Year, to the Intereſt ſought.

20. Requir'd the Intereſt of 372 *l.* 15 *s.* 10 *d.* at 5 *per Cent.* from the 20th of *March* 1757, to the 9th of *April* ditto? Anſwer 1 *l.* 0 *s.* 5 *d.* $\frac{9}{73}$.

21. Requir'd the Intereſt of the above Principal for 4 Years at $5\frac{1}{2}$ *per Cent.* (or for $5\frac{1}{2}$ Years at 4 *per Cent?*) Anſwer 370 *l.* 6 *s.* 8 *d.*

22. Requir'd the Intereſt of 841 *l* 13 *s.* 4 *d* for 1 Year and 6 Months, at $4\frac{1}{2}$ *per Cent?* Anſwer 56 *l.* 16 *s.* 3 *d.*

23. Requir'd the Intereſt of 1683 *l.* 6 *s.* 8 *d.* for 4 Years and 9 Months, at $5\frac{3}{4}$ *per Cent?* Anſwer 459 *l.* 15 *s.* 2 *d.* $\frac{1}{2}$.

24. Requir'd the Intereſt of 210 *l.* 8 *s.* 4 *d.* at $5\frac{3}{4}$ *per Cent. per Annum*, for 8 Years and 73 Days? Anſwer 99 *l.* 4 *s.* 2 *d.* $\frac{3}{4}$.

Note, If inſtead of the Intereſts the Amounts were requir'd in the 4 laſt Queſtions, they are as follows, *viz.* in the 21ſt 2053 *l.* 13 *s.* 4 *d.* — in 22d 898 *l.* 9 *s.* 7 *d.* — in 23d 2143 *l.* 1 *s.* 10 *d.* $\frac{1}{2}$. — and in 24th 309 *l.* 12 *s.* 6 *d.* $\frac{3}{4}$.

25. What is the Amount of 1683 *l.* 6 *s.* 8 *d.* from *Chriſtmas-day* 1755, to the 19th of *March* following, at 5 *per Cent?* Anſwer 1702 *l.* 18 *s.* 8 *d.* $\frac{8}{73}$.

26. A Gentleman borrows 1683 *l.* 6 *s.* 8 *d.* for 1 Year, at $5\frac{1}{2}$ *per Ct. per Annum*, with Condition to pay as much of the Principal before the Expiration of the Year, as he thinks proper: Now if he pays at the End of 3 Months $\frac{1}{3}$ of the Principal, and 4 Months after that $\frac{1}{4}$ of the Remainder; I demand

how much is due at the Expiration of the Year for Principal and Intereſt? Anſwer 904 *l.* 13 *s.* 5 *d.* $\frac{5}{6}$.

CASE 2d. Commonly call'd Diſcompt.

Given the Amount, Rate, and Time, to find the Principal (call'd the Preſent Worth) or Intereſt (call'd the Diſcompt.)

1ſt. *To find the Principal (or Preſent Worth.)*

RULE.

As the Amount of 100 *l.* for the given Time, to 100 *l.* ſo is any other Amount to its Principal (or Preſent Worth) which ſubtracted from the given Amount, leaves the Diſcompt.

2d. *To find the Intereſt (or Diſcompt.)*

RULE.

As the Amount of 100, to the Intereſt of 100 *l.* for the given Time, ſo is any other Amount to its included Intereſt (or Diſcompt) for ſaid Time, which ſubtracted from the given Amount, leaves the preſent Worth.

1. I have a Gentleman's Note for 315 *l.* payable one Year hence; what is the preſent Value of the Note? Or, how much muſt I allow him if he now pays off the Debt in ready Money, diſcompting at 5 *per Cent?*

```
        A.      P.      A.
1ſt.   105     100     315
       ———             ———
        21              63
       ———             ————
         7          7 ) 2100
                       ————
```

Anſwer 300 *l.* the preſent Value.

Or thus:

A. I. A.
2d. 105 5 315
7)———
3)41
——

Anſwer 15 *l.* the Diſc. or Sum to be deducted.

2. What is the preſent Worth of a Debt of 416 *l.* 12 *s.* 9 *d.* $\frac{3}{5}$, payable 3 Years hence, allowing Diſcompt at 4 *per Cent?*

A. P. A.
l. *s.* *d.*
112 100 416 12 9 $\frac{3}{5}$
5 20
—— ——
560 8332
12
——
99993
5
——
8|0)4999680|0
——
7)624960
——
12)89280
——
2|0)7444|0
——
372 *l.* the preſent Worth.

l. *s.* *d.*
416 12 9 $\frac{3}{5}$ Am.
372 Princ.
——————
Anſ. 44 12 9 $\frac{3}{5}$ the Diſc.
= the Intereſt of 372 *l.* for 3 Years, at 4 *per Ct. per Annum.*

QUESTIONS.

3. Requir'd the Diſcompt of 1695 *l.* 19 *s.* 2 *d.* at $\frac{3}{4}$ *per Cent. per Annum* for 1 Year? Anſwer 12 *l.* 12 *s.* 6 *d.*

4. Requir'd the Diſcompt of 1775 *l.* 18 *s.* 4 *d.* for 1 Year, at $5\frac{1}{2}$ *per Cent?* Anſwer 370 *l.* 6 *s.* 8 *d.*

5. What is the Diſcompt of 2053 *l.* 13 *s.* 4 *d.* for 4 Years, at $5\frac{1}{2}$ *per Cent?* Anſwer 92 *l.* 11 *s.* 8 *d.*

6. How much preſent Money is equivalent to a Debt of 898 *l.* 9 *s.* 7 *d.* payable at $1\frac{1}{2}$ Years hence, diſcompting at $4\frac{1}{2}$ *per Cent?* Anſwer 841 *l.* 13 *s.* 4 *d.*

7. How much ready Money ſhould I pay for a Note of Hand for 309 *l.* 12 *s.* 6 *d.* $\frac{3}{4}$ payable in 8 Years and 73 Days, diſcompting at $5\frac{3}{4}$ *per Cent?* Anſwer 210 *l.* 8 *s.* 4 *d.*

8. How much ready Money ſhould be paid on *Chriſtmas-day* 1755 for a Note of 1702 *l.* 18 *s.* 8 *d.* $\frac{8}{73}$, which is not payable till the 19th of *March* following, allowing Diſcompt at 5 *per Cent?* Anſwer 1683 *l.* 6 *s.* 8 *d.*

CASE 3d.

Given the Principal, Rate and Intereſt, to find the Time.

RULE.

100 Times the Intereſt, divided by the Product of the Principal and Rate, quotes the Time.

CASE 4th.

Given the Principal, Time and Intereſt, to find the Rate.

RULE.

100 Times the Intereſt, divided by the Product of the Principal and Time, quotes the Rate.

N. B. All the given Terms are conſidered as abſtract, and conſequently the mixt Part of every Term muſt be reduc'd to a Fraction of the Denomination of the integral Part.

Examp. to CASE 3d.

In what Time will 1683 *l.* 6 *s.* 8 *d.* gain 370 *l.* 6 *s.* 8 *d.* at $5\frac{1}{2}$ *per Ct. per Annum?*

Principal $1683\frac{1}{3}$

5050

Rate $5\frac{1}{2}$

25250

2525 $370\frac{1}{3}$ Intereſt.

Product of Principal and Rate } = 27775) 111100(Am. in 4 Years

Note, Here both Diviſor and Dividend are tripled, and conſequently this cannot affect the Quote.

Examp. to CASE 4th.

At what Rate *per Ct. per Annum* will 1683 *l.* 6 *s.* 8 *d.* gain 370 *l.* 6 *s.* 8 *d.* in 4 Years?

$1683\frac{1}{3}$

5050 $370\frac{1}{3}$

4

1111 | 00 (Anſ. at $5\frac{1}{2}$ *per Ct. per Ann.*

202|00 101 | 1

202 | 2

QUESTIONS.

3. In what Time will 1683 *l.* 6 *s.* 8 *d.* gain 4 *l.* 4 *s.* 2 *d.* at 1 *per Cent. per Annum?* Anſwer in 3 Months.

4. In what Time will 841 *l.* 13 *s.* 4 *d.* gain 56 *l.* 16 *s.* 3 *d.* at $4\frac{1}{2}$ *per Cent. per Annum?* Anſwer $1\frac{1}{2}$ Year.

5. In what Time will 1683 *l.* 6 *s.* 8 *d.* amount to 2143 *l.* 1 *s.* 10 *d.* $\frac{1}{2}$, at $5\frac{3}{4}$ *per Cent?* Anſwer $4\frac{3}{4}$ Years.

If in the three laſt Queſtions we change the requir'd Times into given Times, and then require the Rates, the Anſwers will be the ſame as the foregoing given Rates; and theſe Queſtions belong to Caſe 4.

6. What is the Difference betwixt the Intereſt and the Diſcompt of 100 *l.* for 1 Year, at 5 *per Cent?*

A.	Dif.	A.
105	5	100
21)	100	
	16	
	20	
	320	
	110	
	5	
	12	
	60	
	18 | 6	
	21 | 7	

5 *l.*		the Int. of 100 *l.* for 1 Year.
4 *l.*	15 *s.* 2 *d.* $\frac{6}{7}$	the Diſc. of 100 *l.*
	4 $9\frac{1}{7}$	

Anſwer 4 *s.* 9 *d.* $\frac{1}{7}$ is the Difference ſought, that is, the Intereſt of 100 *l.* for 1 Year exceeds the Diſcompt of 100 *l.* for 1 Year, by 4 *s.* 9 *d.* $\frac{1}{7}$.

A late Author directs to take proportional Parts out of a Year's Diſcompt, for any time leſs than a Year; but that this Rule is falſe will appear from the following Example (or any other).

7. Examp. What is the Diſcompt of 1000 *l.* for 3 Months, at 8 *per Cent. per Annum?*

	l.	*s.*	*d.*
The Anſwer, according to Truth, is	19	12	$1\frac{15}{17}$
But according to the Author ment' 'tis	18	10	$4\frac{4}{9}$
Which laſt is too little by	1	1	$9\frac{67}{153}$

8. In what Time will any Principal double itſelf at 5 *per Cent?* Anſwer in 20 Years.

9. At what Rate will any Principal quadruple itſelf in 100 Years? Anſwer at 3 *per Cent.*

10. What is the Difference betwixt the Intereſt of 1683 *l.* 6 *s.* 8 *d.* and the Diſcompt of 2053 *l.* 13 *s.* 4 *d.* for 4 Years, at 5 ½ *per Cent. per Annum?* Anſwer, there is no Difference.

COMPOUND INTEREST.

DEFINITION.

THIS is call'd compound Intereſt, becauſe (there being as many different Principals as there are Years, or Times) every ſucceeding Principal is a Compound, made of the laſt Principal and Intereſts; 'tis alſo call'd Intereſt upon Intereſt, becauſe there is Intereſt paid for the Intereſt as well as the Principal.

RULE.

Find the ſimple Intereſt of the given Principal for the firſt Year, and then take the Sum of the Principal and Intereſt as a Principal for the 2d Year, and again take the Sum of the laſt Principal and Intereſt as a Principal for the 3d Year; and ſo on according to the Number of Years given.

Examp. Requir'd the compound Intereſt of 372 *l.* for 3 Years, at 4 *per Cent*.

l.
372
20

7440
12

89280 the given Principal.
× 4

3571 | 20 | = the 1ſt Year's Intereſt.
89280 = the 1ſt Year's Principal.

92851 = the 2d Year's Principal.
× 4

3714 | 04 | = the 2d Year's Intereſt.
92851 = the 2d Year's Principal.

96565 = the 3d Year's Principal.
× 4

3862 | 60 | = the 3d Year's Intereſt.

3571 = 1ſt Year's Intereſt.
3714 = 2d Year's Intereſt.
3862 = 3d Year's Intereſt.

Anſwer 11147 Pence = the Intereſt ſought.
12)
20) 92 | 8 *s.* 11 *d.*

Anſwer 46 8 11 { Which exceeds the ſimple Intereſt by 1 *l.* 16 *s.* 2 *d.*

Note, The Fractions rejected are inſignificant, for they do not amount to a Penny, being only $\frac{2681}{3125}$ D;

for which reaſon I ſhall reject them in the Solutions to the following Queſtions.

l. Or thus:

$$\begin{array}{rl}
89280 & = \text{the given Principal.} \\
\times 4 & \\
\hline
3571|20 & \\
4 & \\
\hline
142|84 & \\
+\ 7142 & \\
\hline
7284 & \\
\times 4 & \\
\hline
291\frac{1}{2}|36 & \\
142\frac{1}{2} & \\
10713 & \\
\hline
\end{array}$$

Anſwer 11147 = 46 *l.* 8 *s.* 11 *d.*.

Requir'd the Amount of 500 *l.* for 2 Years, at 5 *per Cent.* compound Intereſt? Anſwer 551 *l.* 5 *s.*

What is the Amount of 841 *l.* 13 *s.* 4 *d.* for 18 Months, at 4 ½ *per Cent.* compound Intereſt? Anſwer 899 *l.* 6 *s.* 7 *d.* ½.

What is the Amount of 210 *l.* 8 *s.* 4 *d.* for 3 ¾ Years, at 5 ¾ *per Cent.* compound Intereſt? Anſwer 259 *l.* 9 *s.* 8 *d.*

Requir'd the Amount of 476 *l.* 19 *s.* for 2 ½ Years, at 6 *per Cent,* compound Intereſt? Anſwer.

EXCHANGE.

ALL Queſtions in this Rule being ſolv'd by the Rule of Three, or Practice, I ſhall give the Work of but one Example.

If 1 *l.* Sterling is equal to 33 *s.* 4 *d.* *Flemiſh*, how many *l.* ſterling are equal to 333 *l.* 6 *s.* 8 *d.* *Flemiſh*?

$$\begin{array}{llllll} s. & d. & l. & l. & s. & d. \\ 33 & 4 & —1— & 333 & 6 & 8 \\ 3 & & & 20 & & \\ \hline 100 & & & 6666 & & \\ & & & 3 & & \\ \hline & & 1|00) & 200|00 & & \end{array}$$

Anſwer 200 *l.* Sterling.

or thus:

$$\begin{array}{lll} l. & s. & d. \\ 333 & 6 & 8 \\ & & \times 3 \\ \hline 5)\ 1000 & & \end{array}$$

Anſwer 200 *l.*

Becauſe $\frac{400}{240} = \frac{5}{3}$.

If 33 *s.* 4 *d.* *Flemiſh* be equal to 1 *l.* Sterling, how many *l.* *Flemiſh* are equal to 200 *l.* Sterling?

$$\begin{array}{llllll} & & & & 200\ l. & \\ 10\ s. & & = \frac{1}{2} = & 100 & & \\ 3 & 4\ d. & = \frac{1}{6} = & 33 & 6\ s. & 8\ d. \\ \hline \end{array}$$

Anſwer 333 6 8 *Flemiſh*.

QUESTIONS.

3. If *London* Exchange with *Hamburgh* at 33 *s.* 4 *d.* *Flemiſh per l.* Sterling, what is the ſterling Value of 360 Gilders, 15 Stivers? Anſwer 36 *l.* 1 *s.* 6 *d.* Sterling.

4. What is the ſterling Value of a Gilder and Stiver ſeverally, at the above Rate? Anſwer, a Gilder is worth 2 *s.* and a Stiver 1 $\frac{1}{5}$ *d.* Sterling.

5.

5. What is the *Flemiſh* Value of 36 *l.* 1 *s.* 6 *d.* Sterling, at the above Rate? Anſwer 60 *l.* 2 *s.* 6 *d.* *Flemiſh.*

6. If 60 *l.* 2 *s.* 6 *d.* *Flemiſh* be equal to 36 *l.* 1 *s.* 6 *d.* Sterling, what is the *Flemiſh* Value of 1 *l.* Sterling? Anſwer 33 *s.* 4 *d.* or 10 Gilders, or 200 Stivers, or 3200 Pennings.

7. If 33 *s.* 4 *d.* *Flemiſh* be equal to 1 *l.* Sterling, what is the ſterling Value of 1 *l.* *Flemiſh?* Anſwer 12 *s.* Sterling.

N. B. All the following Queſtions may be thus vary'd, and therefore I ſhall omit the Variations, leaving them for the Scholar's Exerciſe.

8. How many *l.* Sterling in 486 *French* Crowns, 2 Livres, 10 Sols, 6 Deniers, Exchange at 4 *s.* 6 *d.* Sterling *per* Crown? Anſwer 106 *l.* 8 *s.* 3 *d.* $\frac{9}{28}$.

9. In 56 *l.* 10 *s.* Sterling, how many *French* Crowns, Exchange at 64 *d.* each? Anſwer 211 $\frac{7}{8}$ Crowns.

10. How many Rix Dollars at 4 *s.* 5 *d.* $\frac{3}{4}$, and *Cadiz* Ducats at 5 *s.* 6 *d.* $\frac{1}{4}$, triple as many of the former as of the latter, muſt I receive in exchange for 500 *Portugal* Teſtoons, at 15 *d.* and double as many Pieces of Eight at 4 *s.* 6 *d.* each? Anſwer 243 $\frac{57}{101}$ Rix Dollars, and 730 $\frac{70}{101}$ *Cadiz* Ducats.

10. A Caſhier having receiv'd a Bill of 339 *l.* 12 *s.* Sterling, is deſirous of exchanging it for *Zealand* Dollars at 3 *s.* *Lyons* ditto at 4 *s.* and Specie Dollars at 5 *s.* of each an equal Number, how many ſhould he receive of each ſort? Anſwer 566.

11. Suppoſing there were requir'd 2 *Zealand* for 3 *Lyons*, and 2 *Lyons* for 1 Specie, how many of each kind? Anſwer 532 $\frac{12}{17}$ *Zealand*, 799 $\frac{1}{17}$ *Lyons*, and 399 $\frac{9}{17}$ Specie.

Loss

Loss and Gain.

1. Bought 300 Yards of Cloth at 10 *s.* *per* Yard, which I ſold at 12 *s.* 6 *d.* what is the Gain upon the whole?

12 6
10
—
2 6 = $\frac{1}{8}$) 300
—
Anſwer 37 10 *s.* gain'd.

2. In the foregoing Caſe, what is the Gain *per Cent?*

thus:
10 *s.* 2 *s.* $\frac{1}{2}$ 100 *s.*
5
—
2) 500
—
1|0) 25|0
—
Anſwer 25 *per Cent.* Gain.

or thus:
15|0 *l.* 37 $\frac{1}{2}$ 100 *l.*
— 2 —
3 — 2
) 75
—
Anſwer 25 *per Cent.*

3. Bought Goods for 187 *l.* 10 *s.* which I ſold at the Rate of 25 *per Cent.* Loſs, requir'd the ſelling Price.

Loſs
100 25 187$\frac{1}{2}$
—
8) 375
—
46 17 6 Total Loſs.
187 10 Prime Coſt.
—
Anſwer 140 12 6 Sold for.

4.

4. Bought Goods for 187 *l.* 10 *s.* which I ſold for 150 *l.* requir'd the Loſs *per Cent.*

187½ 150 100
— 4
375 —
5) 400
—
— 80
100
—
Anſwer 20 *per Cent.* Loſs.

Or thus:

187½
— 150
—
187½ 37½ 100
— — 5) —
375 75 Anſwer 20 *per Cent.*

5. Suppoſe in the ſecond Caſe I had given the Buyer 4 Months Credit, what is the Gain *per Cent. per Annum?*

m. g. m.
4 25 12
— 3 —
1 — 3
Anſwer 75 *per Cent. per Annum.*

6. In the laſt Caſe, what is the preſent Gain, ſuppoſing for prompt Payment I allow Diſcompt at the ſame Rate as the Sale imply'd Gain? Anſwer, I loſe 73 *l.* 9 *s.* 4 *d.* $\frac{32}{49}$.

7. *Peter* buys Beer at the Rate of 2 *d. per* Pot, and ſells it to *Paul* at the Rate of 3 *d. per* Pot; *Paul* being neceſſitated for Money, ſells it again at the Rate of 2 *d. per* Pot, I demand the Gain and Loſs reſpectively, with regard to the Principal, and

the Difference of the Sales *per Cent.* Anſwer, *Peter* gains $\frac{1}{2}$, and *Paul* loſes $\frac{1}{3}$, and the Difference *per Cent.* is 83 $\frac{1}{3}$.

8. If I buy Goods at 18 *s.* 8 *d.* *per* C. and ſell them at 28 *s.* what do I gain *per* ℔? Anſwer 1 *d.*

9. Bought 360 C. 2 q. at 2 *l.* 10 *s.* *per* C. paid Cellarage 3 *l.* 5 *s.* Porterage 2 *l.* 10 *s.* Boat-hire 20 *s.* at what Rate muſt theſe Goods be ſold *per* Ton to gain 173 *l.* by the whole, and what is the Gain *per* C? Anſwer, they muſt be ſold at 3 *l.* *per* Ton, and then the Gain will be 19$\frac{12}{227}$ *per* C.

10. If I buy a Yard of Stuff for 7 *s.* and ſell it for 6 *s.* 6 *d.* how much *per Cent.* do I loſe? Anſwer 7 $\frac{1}{7}$ *per Cent.*

11. If I buy Lemons at the Rate of 5 for 4 *d.* and ſell them at 6 for 5 *d.* what is the Gain upon 1000 Lemons? and how much do I gain *per Cent?* Anſwer, the Gain is 33 $\frac{2}{3}$ *d.* and Gain *per Cent.* 4 $\frac{5}{24}$.

12. Bought 15 Pieces of Serge, each containing 21 Yards, at 13 *d.* *per* Ell *Flemiſh*, how muſt I ſell it *per* Ell *Engliſh* to gain by the whole the prime Coſt of 1 Piece? Anſwer 23 $\frac{1}{9}$ *d.*

13. Suppoſe the foreſaid Cloth were bought wet, and had ſhrunk in my Shop 4 Ells *Engliſh*, how muſt I ſell it *per* Yard to gain 20 *per Cent?* Anſwer 21 $\frac{4}{31}$ *d.*

14. A Merchant having bought 20 equal Pieces of broad Cloth for 200 *l.* finds to have gain'd 40 *per Cent.* by ſelling it at 17 *s.* 6 *d.* *per* Ell *Engliſh*, I demand how many Yards were in each Piece? Anſwer 20 Yards.

15. If by ſelling Wheat at 37 *s.* 6 *d.* *per* Sack, I find to have gain'd 25 *per Cent.* and by ſelling (when the Price was riſen) another Parcel of the ſame Wheat for 22 *l.* 10 *s.* find to have gain'd 50 *per Cent.* I demand how many Buſhels were in the laſt Parcel (allowing 5 Buſhels to a Sack) and at what

Rate I ſold them? Anſwer, 50 Buſhels at 9 *s. per* Buſhel.

16. Having ſold Wheat for 18 *l.* 15 *s.* I find to have gain'd at the Rate of 25 *per Cent.* ſuppoſing the Money to be preſently paid; but having given 3 Months Credit, I deſire to know the ready Money Gain, and the Gain *per Cent. per Annum*, allowing the Rates of the Diſcompt and Intereſt to be equal? Anſwer, the preſent Gain is 2 *l.* 12 *s.* $\frac{16}{17}$, and the Gain *per Annum* is *Cent. per Cent.*

17. Having gain'd at the Rate of 25 *per Cent. per Annum* by the Sale of Wheat, which I bought for 15 *l.* and ſold for 18 *l.* 15 *s.* 'tis requir'd to determine the Time allow'd for Payment? Anſwer, 3 Months.

18. A Cornfactor buys Wheat for 15 *l.* ready Money, and by ſelling the ſame with 3 Months Credit, gains at the Rate of 25 *per Cent. per Annum*, I demand the ſelling Price? Anſwer 18 *l.* 15 *s.*

19. A Cornfactor ſells Wheat for 18 *l.* 15 *s.* giving 3 Months Credit, and gains at the Rate of 25 *per Cent. per Annum*, requir'd the prime Coſt? Anſwer 15 *l.*

B A R T E R

IS the exchanging of one Commodity for another, upon equal or unequal Terms; and all Caſes of this Rule may be ſolv'd by the Rule of Three.

1. How many ℔. of Sugar, worth 8 *d. per* ℔. muſt be given in barter for 15 C. 3 q. of Butter worth 50 *s. per* C. but barter'd at 3 *l. per* C. and how muſt the Sugar be rated to make the Barter equal?

15 5|0 6|0 8
50 8

750 5) 48
25
12 6 Anſ. 9 $\frac{3}{5}$ *d. per* ℔. the barter Price of the Sugar.

787 6
12

8) 9450

Anſwer 1181 $\frac{1}{4}$ ℔. of Sugar muſt be given.

Or thus:

15
60

900
15
30

945
12

11340
9 $\frac{3}{5}$ 5

48) 56700 (1181 $\frac{1}{4}$ ℔. of Sugar.
87
390
60
12 | 1

48 | 4

N. B. Here it is evident, that the barter Prices are not neceſſary in finding the Quantity of the Sugar, nor are the Quantities neceſſary in finding the barter Price; though moſt Authors ſeem to think the former abſolutely neceſſary, by their Method of Solution, *viz.* by finding the barter Prices firſt, and then exchanging at thoſe Rates. However, either Method will give a true Solution in this Caſe; but in ſome particular Caſes, the common Method will lead the Arithmetician into Errors.

2. *A* and *B* barter thus; *A* has 100 Yards of Cloth worth 12 *s.* *per* Yard ready Money, but in Barter he will have 13 *s.* 6 *d.* and will have alſo $\frac{1}{4}$ of the barter Value in ready Money; *B* hath Sugar at 8 *d.* a ℔. how much Sugar ought *B* to deliver, and how is it to be rais'd to equal the Barter?

Yds.
s. *d.* *d.* 100
13 6 = 162
4) 16200 = tot. barter Price
d. Yd. 100
144 : 1 :: 4050 *d.* : $28\frac{1}{8}$ Yd.
Yd. *d.* Yd. $71\frac{7}{8}$
1 : 144 :: $71\frac{7}{8}$: 10350 *d.*
8)
$1293\frac{3}{4}$. Sugar delivered.

12 : $13\frac{1}{2}$: 8
8
12) 108
Anſwer 9 *d.*

Or thus:
14400 : 16200
— 4050 — 4050
10350 : 12150 :: 8 (: $9\frac{9}{23}$ *per* ℔. Serge in barter.
$9\frac{9}{23}$ *d.* : 1 ℔. :: 12150 (: $1293\frac{3}{4}$ Sugar.

QUESTIONS.

3. How many Yards of Cloth at 12 *s.* muſt I give in barter for 15 Yards at 15 *s*? Anſwer $18\frac{3}{4}$ Yards.

4. Suppoſe I raiſe my Cloth (in the foreſaid Caſe) to 15 *s.* how high muſt he raiſe his to make the

Barter equal? Anſwer, he muſt raiſe his to 18 *s.* $\frac{3}{4}$ *per* Yard.

5. *A* has Cloth worth 15 *s. per* Yard, and *B*'s Cloth is worth 12 *s. per* Yard, how high muſt *B* put his Cloth to gain 10 *per Cent.* by the Barter? Anſwer 13 *s.* 2 $\frac{2}{3}$ *d. per* Yard.

6. How low muſt *A* put his Cloth to loſe 10 *per Cent?* Anſwer at 13 *s.* 6 *d.*

7. How muſt *B* rate his Cloth to make *A* loſe 10 *per Cent.* by the Barter? Anſwer 13 *s.* 4 *d.*

8. *A* gives to *B* 15 Yards of Serge at 15 *d. per* Yard for 18 $\frac{3}{4}$ ℔. of Pepper, what is the Pepper *per* ℔? Anſwer 1 *s.*

9. *A* has Sugar which he barters at 3 *d.* a ℔. more than it coſt him; *B* has Pepper which coſt him 15 *d. per* ℔. but puts it at 18 *d.* $\frac{3}{4}$ *per* ℔. I demand the prime Coſt of the Sugar? Anſwer 1 *s.*

10. *A* has Sugar at 12 *d. per* ℔. *B* has Pepper at 15 *d.* and they have both a mind to gain 10 *per Cent.* how high muſt they put their Goods? Anſwer, Sugar 13 $\frac{1}{5}$ *d.* and the Pepper 16 $\frac{1}{2}$ *d.*

11. *A* and *B* barter upon equal Terms; *A* puts his Goods at 17 *s.* 3 *d.* which coſt him but 15 *s.* now if *B* puts his Goods at 13 *s.* 9 $\frac{3}{5}$ *d.* I demand the prime Coſt? Anſwer 12 *s.*

12. *A* has Goods which coſt him 12 *s.* *B* has Goods which coſt him 15 *s.* now if *A* puts his Goods at 15 *s.* and receives $\frac{1}{4}$ of this advanc'd Price in ready Money, tell me how high *B* muſt put his Goods to be even with *A?* Anſwer 20 $\frac{1}{11}$ *s.*

13. *A* has 18 $\frac{3}{4}$ Yards of Broad-cloth, which is worth but 12 *s. per* Yard ready Money, but in trucking with *B* he inſiſts upon 15 *s.* for every Yard, and alſo $\frac{1}{4}$ of the barter Price in ready Money; now if *B*'s Cloth is worth 15 *s. per* Yard ready Money, I demand how high he muſt put it *per* Yard to equal the Barter (or prevent *A*'s having any Advantage of him in the whole.) Anſwer 20 $\frac{1}{11}$ *s.*

14. *A* has 18 $\frac{3}{4}$ Yards of Broad-cloth worth 12 *s.* *per* Yard ready Money, but in Barter puts it at 15 *s.* and makes his Agreement to have $\frac{1}{4}$ of the barter Price in ready Money; now if the barter Price of *B*'s Cloth (which is worth 15 *s.* *per* Yard ready Money) be rais'd in the ſame Proportion as that of *A*'s, I demand how *B* muſt rate his Cloth, how many Yards he muſt deliver, and how many Yards he muſt receive at the ready-money Price? Anſwer, *B* muſt deliver 10 $\frac{5}{16}$ Yards, at 18 *s.* 4 *d.* and he muſt receive 5 $\frac{11}{64}$ Yards at 12 *s.* *per* Yard for his ready Money (the reſt he receives in Barter at 15 *s.* *per* Yard.)

15. *A* and *B* barter thus; *A*'s Goods are worth 12 *s.* ready Money, but he puts them at 15 *s.* and gives 12 Months Time; *B*'s Goods are worth 15 *s.* ready Money, and he gives 9 Months; how muſt *B* rate his Goods to make the Barter equal? Anſwer at 17 $\frac{13}{16}$ *s.*

Alſo the prime Coſt or Time may be requir'd.

SINGLE FELLOWSHIP.

RULE.

AS the total Stock to the total Gain (or Loſs) ſo is each Man's Stock to his Gain (or Loſs) and *vice verſâ.*

1. *A*, *B* and *C* enter into Company; *A* puts in 360 *l.* *B* 482 *l.* *C* 720 *l.* they gain 162 *l.* 10 *s.* what is each Man's Share of the Gain in Proportion to his Stock?

A = 360 Sk. Gain. Sk. G.
B = 480 156 : 162 . 10 :: 48 : 50 *B*'s Gain.
C = 720

Gain. Stk. Sk. Gain. Sk. G.
156|0 : 162 . 10 :: 360 — 156 : 162 . 10 :: 72 : 75
(*C*'s Gain.

$\times 6$

975
$\times 6$

l. s.
156) 5850 (37 10 *A*'s Gain
1170
78
20

156) 1560

	l.	*s.*	
Anſwer	37	10	= *A*'s G.
	50		= *B*'s G.
	75		= *C*'s G.
Proof	162	10	the given total Gain.

Or thus:

÷ 12 { 36 | 0 3
48 | 0 4
72 | 0 6

13) 162$\frac{1}{2}$

	12$\frac{1}{2}$	12$\frac{1}{2}$	12$\frac{1}{2}$
	× 3	× 4	× 6
Anſwer	37 10	50	75

2. 4 Men *A*, *B*, *C*, *D* buy a Sheep for 20 *s.* and they agree to pay thus, *viz.* *A* $\frac{1}{3}$, *B* $\frac{1}{4}$, *C* $\frac{1}{5}$, *D* $\frac{1}{6}$ of the Price, how much muſt each Man pay of the 20?

Here it muſt be obſerv'd, that as theſe Parts of the 20 *s.* being added together, make up but 19 *s.* therefore it can only be meant that they are to pay in the Proportion of theſe Parts; and the Reaſon of this Deficiency is, that the Sum of theſe Fractions is leſs than 1. Hence, as the Sum of theſe Fractions to 20 *s.* ſo is each Fraction to its reſpective Part.

(60 *s.* *s.*
$\frac{1}{3} = 20$ 57 : 20 :: 20 (: 7 $\frac{1}{57}$ = *A*'s Payment.
$\frac{1}{4} = 15$ 57 : 20 :: 15 (: 5 $\frac{15}{57}$ = *B*'s Ditto.
$\frac{1}{5} = 12$ 57 : 20 :: 12 (: 4 $\frac{12}{57}$ = *C*'s Ditto.
$\frac{1}{6} = 10$ 57 : 20 :: 10 (: 3 $\frac{29}{57}$ = *D*'s Ditto.
—— ——
57 Proof 20 *s.* the given Price.
——
60

(20 *s.* Or thus:
6 8 *d.* *s.* *s.* *s.* *d.* *s.*
$\frac{1}{4}$ 6 19 : 20 :: 6 8 : 7 $\frac{1}{57}$
$\frac{1}{5}$ 4 19 : 20 :: 5 0 : 5 $\frac{15}{57}$
$\frac{1}{6}$ 3 4 19 : 20 :: 4 0 : 4 $\frac{12}{57}$ } as before.
—— 19 : 20 :: 3 4 : 3 $\frac{29}{57}$
Sum = 19 *s.*

3. *A*'s Stock 360; *B* 480; *C* 720, they gain at 10 *per Cent.* requir'd each Man's Gain?

Gain.
Anſwer { *A*'s = 36 | 0
B's = 48 | 0
C's = 72 | 0

QUESTIONS.

4. *A*'s Stock is 120 *l.* 16 *s.* *B*'s 34 *l.* 15 *s.* *C*'s 100 *l.* 13 *s.* 6 *d.* they gain 85 *l.* 8 *s.* 2 *d.* what is each Man's Share of the Gain? Anſwer, *A* 40 *l.* 5 *s.* 4 *d.*—*B* 11 *l.* 11 *s.* 8 *d.*—and *C* 33 *l.* 11 *s.* 2 *d.*

5. *A*'s Stock is 16 *l.* 4 *s.* 6 *d.* *B*'s is 20 *l.* 8 *s.* 9 *d.* *C*'s 36 *l.* 5 *s.* 9 *d.* they loſe by Trade 18 *l.* 4 *s.* 9 *d.* requir'd each Man's Loſs? Anſwer *A*'s 4 *l.* 1 *s.* 1½ *d.* *B*'s 5 *l.* 2 *s.* 2¼ *d.* *C*'s 9 *l.* 1 *s.* 5¼ *d.*

6. Two Perſons are to ſhare a Legacy of 36 *l.* 18 *s.* 6 *d.* *A* is to have ½, and *B* ¼, requir'd each Man's Share? Anſwer *A* 24 *l.* 12 *s.* 4 *d.* and *B* 12 *l.* 6 *s.* 2 *d.*

7. An old Miſer (ignorant of Figures) leaves 162 *l.* 10 *s.* to his 3 Brothers, in this manner, *viz.* to his Brother *Pinchgut* (his only Favourite) $\frac{1}{2}$, to *Cloſe Purſe* $\frac{1}{3}$, and to *Prodigal Dick* only $\frac{1}{4}$, how muſt this Sum be divided among them according to the Donor's Intention? Anſwer, *Pinchgut* 75 *l.* *Cloſe Purſe* 50 *l.* and poor *Dick* only 37 *l.* 10 *s.*

8. A Merchant being deceas'd, 'tis found that he is indebted to *A* 162 *l.* 10 *s.* which is the Whole of his Eſtate, and to *B* $\frac{1}{2}$ as much, how muſt the 162 *l.* 10 *s.* be divided betwixt theſe two Creditors? Anſwer, *A* muſt have 108 *l.* 6 *s.* 8 *d.* and *B* 54 *l.* 3 *s.* 4 *d.*

9. Three Perſons are to ſhare 162 *l.* 10 *s.* *A* is to have a certain Sum, *B* three times as much, and *C* 4 times as much as *B*, what is each Man's Share? Anſwer, *A* 10 *l.* 3 *s.* 1$\frac{1}{2}$ *d.* *B* 30 *l.* 9 *s.* 4$\frac{1}{2}$ *d.* *C* 121 *l.* 17 *s.* 6 *d.*

10. Three Merchants, by a Joint-ſtock, gain 60 *l.* 13 *s.* 4 *d.* of which *A* takes 20 *per Cent.* more than *B*; and *C*'s Stock is to *B*'s, as *B*'s is to *A*'s; I demand each Man's Gain? Anſwer *A* gains 24 *l.* *B* 20 *l.* and *C* 16 *l.* 13 *s.* 4 *d.*

11. *A*, *B*, *C* make a Joint-ſtock of 360 *l.* of which *C* puts in 150 *l.* and as often as *A* puts in 3 *l.* *B* puts in 4 *l.* they gain at the Rate of 10 *per Cent.* I demand *A*'s and *B*'s Stock and Gains, and *C*'s Gain? Anſwer, *A*'s Stock is 90 *l.* his Gain 9 *l.* *B*'s Stock is 120 *l.* his Gain 12 *l.* and *C*'s Gain is 15 *l.*

FELLOWSHIP WITH TIME.

RULE.

MULTIPLY every Man's Stock by his Time; then as the Sum of theſe Products, to the total Gain (or Loſs) ſo is each Man's Product to his Gain (or Loſs.)

1. *A* puts in 360 *l.* for 1 ½ Year; *B* puts in 480 *l.* for 1 Year; and *C* 720 *l.* for ½ a Year, they gain 162 *l.* 3 *s.* what is each Man's Share of this Gain?

	Stock.		Mon.		Prod.
A =	360	×	18	=	6480
B =	480	×	12	=	5760
C =	720	×	6	=	4320

			l.	*s.*		A.	*l.*	*s.*
Sum	16560	:	162	3	::	6480	63	9
	16560	:	162	3	::	5760	56	8
	16560	:	162	3	::	4320	42	6
						Proof	162	3

Or thus:

Sks. Ts.
3 × 3 = 9
4 × 2 = 8
6 × 1 = 6
23

23) 162 3

l.	*s.*		*l.*	*s.*		*l.*	*s.*
7	1		7	1		7	1
	× 9			× 8			× 6
A's 63	9		*B*'s 56	8		*C*'s 42	6

Or thus:

Years.
3 × 1½ = 4½
4 × 1 = 4
6 × ½ = 3
11½) 162 3

14	2		14	2		14	2
	× 4½			× 4			× 3
Anſwer 63	9	—	56	8	—	42	6

2. *A*, *B*, *C* by a Joint-ſtock gain 142 *l.* 2 *s.* 8 *d.* *A* puts in 120 *l.* 16 *s.* for 3 Months, *B* 34 *l.* 15 *s.* for 9 Months, and *C* 100 *l.* 13 *s.* 6 *d.* for 6 Months, what is each Man's Share of the Gain? Anſwer, *A* 40 *l.* 5 *s.* 4 *d.* *B* 34 *l.* 15 *s.* and *C* 67 *l.* 2 *s.* 4 *d.*

3. *A*'s Stock is 30 *l.* 6 *s.* 8 *d.* his Time 3 Months, *B*'s Stock is 20 *l.* 5 *s.* his Time 4 Months; *C*'s Stock is 16 *l.* 3 *s.* 4 *d.* his Time 6 Months, they gain 67 *l.* 10 *s.* I demand each Man's Gain? Anſwer, *A* 22 *l.* 15 *s.* *B* 20 *l.* 10 *s.* and *C* 24 *l.* 5 *s.*

4. *A* puts in 30 *l.* for 30 Months and 10 Days; *B* puts in 40 *l.* for 20 Months and 15 Days; *C* puts in 60 *l.* for 16 Months and 10 Days, they gain 67 *l.* 10 *s.* I demand each Man's Gain? Anſwer, as *per* laſt.

5. Suppoſe in Queſtion 7 of ſingle Fellowſhip, the old Miſer having repented of the Injuſtice done to poor *Dick* (who had the greateſt Family) had made a Codicil to his Will, ſpecifying that his Brothers ſhould not only ſhare his Fortune in proportion to the Terms of his Will, but alſo in proportion to the Number of Children each Brother had, what is the leaſt Number of Children each Man muſt have to make them equal Sharers of his Fortune? Anſwer, *Pinchgut* 2, *Cloſe Purſe* 3, and *Dick* 4.

6. Two Graſiers hire a Piece of Land for 36 *s.* *per* Month (of 30 Days); *A* puts in 5 Oxen for 20 Days; *B* puts in 100 Sheep for 10 Days; now if the graſing of 5 Sheep is allow'd equal to that of 1 Ox, I demand how much each Man muſt pay of the 36 *s*? Anſwer, *A* pays 12 *s.* and *B* 24 *s.*

7. Four Perſons hire a Coach to go 10 Miles for 20 *s.* with condition, that if they take in Company by the Way, the Profit ſhall belong to them; now when they have travel'd 5 Miles they take in 2 Perſons, making their Agreement that each Perſon ſhall pay in the (compound) Proportion of their Number and Diſtance travel'd, how much muſt each Company pay? Anſwer, the 4 firſt muſt pay 16 *s.* and

the 2 laſt 4*s.* (though in ſtrict Juſtice the two laſt ſhould pay but 3*s.* 4*d.*)

8. *A*, *B*, *C* by a Joint-ſtock, in a certain Time gain 116*l.* 4*s.* *A*'s Stock is 20 *per Cent* more than *B*'s, and *C*'s Stock is in proportion to *B*'s, as *B*'s is to *A*'s; alſo *A*'s Time is double of *B*'s, and *B*'s is $\frac{1}{3}$ of *C*'s, I demand each Man's Share of the Gain? Anſwer *A* 48*l.* *B* 20*l.* and *C* 48*l.* 4*s.*

9. *A*, *B*, *C* by a Joint-ſtock gain a certain Sum, which they ſhare equally; *A*'s Money continues in Trade 6 Months; *B*'s 9 Months, and 10 Days (30 to a Month); *C*'s 1 Year and 2 Months: Now if the Sum of the Products of each Man's Stock by his Time is 1260, what is each Man's Stock? Anſwer *A*'s 70*l.* *B*'s 45*l.* and *C*'s 30*l.*

10. Suppoſing all Things as in the laſt, except that the Stocks are given, and the Times ſought? Anſwer, the Times are as above.

THE RULE OF THREE DIRECT AND INVERSE PROMISCUOUSLY.

DEFINITION.

DIRECT, is when the greater the third Term is, the greater the fourth muſt be, and *vice verſâ.*

Inverſe, is when the greater the third Term is, the leſſer the fourth muſt be, and *vice verſâ.*

Note, The firſt and third Terms are call'd Extremes, and the Middle is the Mean.

GENERAL RULE.

When (by the Nature of the Queſtion) the fourth Term muſt be greater than the third, multiply the Mean by the greater Extreme, the Product divided by the other Extreme quotes the fourth Term.

But if the fourth Term muſt be leſs than the third, multiply by the leſſer Extreme, and divide by the other Extreme.

Note, The Stating is the ſame, whether the Queſtion is inverſe or direct; and therefore the Diſtinction need not be regarded till the Queſtion is ſtated, and the Proportion in the inverſe Rule is, as the third Term to the firſt, ſo is the ſecond to the fourth.

Note, If the firſt Term be the Diviſor, the Queſtion belongs to the direct Rule: But if the third Term be the Diviſor, the Queſtion belongs to the inverſe Rule.

1. If 20 Men mow 36 Acres in 40 Days, how many Acres will 80 Men mow in the ſame Time?

M.	A.	M.
20	36	80
	8	

2) 288

Anſwer 144 Acres.

2. If 20 Men mow 36 Acres in 40 Days, in how many Days will 80 Men mow the ſame?

M.	Days.	M.
20	40	80
	20	

8 | 0) 80|0

Anſwer, in 10 Days.

Here it is evident, that the firſt is direct, and the ſecond inverſe; alſo in the firſt the 40 Days are a ſuperfluous Term, and in the ſecond the 36 Acres are ſuperfluous.

3.

3. If 20 Men mow a certain Number of Acres in 40 Days, how many Men can perform the ſame in 10 Days? Anſwer 80 Men.

4. If 20 Men mow 36 Acres in a certain Time, how many Men will mow 144 Acres in the ſame Time? Anſwer 80 Men.

5. If 144 Acres are mow'd by 80 Men, how many Acres will 20 Men mow in the ſame Time? Anſwer 36 Acres.

6. If 80 Men mow a Meadow in 40 Days, how many Men will mow the ſame in 10 Days? Anſwer 20 Men.

7. If in 10 Days 80 Men mow a certain Meadow, in how many Days will 20 Men mow it? Anſwer 40 Days.

8. If 80 Men mow a Meadow of 144 Acres in a certain Time, how many Men will mow a Meadow of 36 Acres in the ſame Time? Anſwer 20 Men.

9. If I lend my Friend 500 *l.* for 5 Months, how long ſhould he lend me 100 *l.* to return the Favour? Anſwer 2 Years, and 1 Month.

10. What muſt the Penny-loaf weigh when Wheat is 6 *s.* 6 *d.* *per* Buſhel, if it weighs 11 Ounces and 8 Penny-weights, when the Wheat is at 5 *s.* a Buſhel? Anſwer 8 oz. 15 $\frac{5}{13}$ dwts.

11. If when the Day is 7 Hours long, I require 4 Days to ride from *London* to *Briſtol*, how many Days will be neceſſary to ride back again at the ſame Rate, when the Days are 16 Hours each? Anſwer 1 Day and 12 Hours.

12. What Principal is that, whoſe Intereſt for 1 Day at any Rate is equal to the Intereſt of 365 Pence for 1 Year at the ſame Rate? Anſwer 555 *l.* 2 *s.* 1 *d.*

13. Suppoſe there are 500 Perſons in a Garriſon, one half whereof are military Men, and the other half Inhabitants; and the Governor finds he has juſt Proviſion enough to ſerve the whole Garriſon four Months, and a Month after this he has 100 Soldiers

ſent into the Garriſon to ſtrengthen him; but finding the Siege will probably laſt one Month longer than he expected, he is determined to turn out ſuch a Number of uſeleſs Mouths as will enable him to hold out yet 4 Months, without changing his Mens Allowance, I demand how many Inhabitants may remain in the Garriſon? Anſwer only 25.

14. How many *Flemiſh* Ells in Length of Paper, that is $1\frac{1}{5}$ of an *Engliſh* Ell in Breadth, will cover the Cieling of a Room that is 16 Foot long, and 12 Foot broad? Anſwer $42\frac{2}{3}$ Ells.

Note, The Product of the Length and Breadth of the Paper muſt be equal to the Product of the Length and Breadth of the Cieling.

THE DOUBLE RULE OF THREE.

THIS is call'd the Double Rule of Three, becauſe it includes two Statings of the ſingle Rule; and when both theſe Statings are direct, 'tis call'd the Double Rule of Three direct.

But when one Stating is direct, and the other inverſe, 'tis call'd the Double Rule of Three inverſe.

However, theſe we ſhall uſe promiſcuouſly; the Diſtinction of direct and inverſe being already taught in the ſingle Rule.

It is call'd the Double Rule of Three compound when the Queſtion is wrought by one Stating (including two Statings of the ſingle Rule.)

To work all Queſtions by one Stating.

A GENERAL RULE.

Make that the middle Term, which is of the ſame kind with the Term ſought, and put the other two Terms of Suppoſition in the firſt Place, the one above the other, and put the remaining two Terms (in like manner) in the third Place.

But obſerve, that the upper Terms in the firſt and third Places, muſt be both of one kind; and conſequently the under Terms will alſo be of one kind.

Then,

If both Statings are direct, multiply the Product of the Terms in the third Place by the middle Term, and divide this Product by the Product of the Terms in the firſt Place, the Quote is the Term ſought.

But if one Stating is inverſe, then multiply the under Number in the firſt Place by the upper in the third, and the under in the third by the upper in the firſt, placing the Products under the reſpective Multiplicands, and conſider theſe Products as your firſt and third Terms; then if the under Stating be direct, apply the direct Rule, but if 'tis inverſe, apply the inverſe Rule.—I ſhall work one Example in each Caſe, both by two Statings and by one, which will be a ſufficient Illuſtration, if well obſerv'd.

Examp. 1ſt, in the direct Rule.

If 20 Men mow 36 Acres in 40 Days, how many Acres will 80 Men mow in 60 Days?

M.	A.	M.	D.	A.	
20	36	80	4|0	144	6|0
	80			6	
	2|0)288|0			4) 864	
	144 Acres.			Anſwer 216 Acres.	

Or thus:

M. 20 A 80 M.
36
D. 40 60 D.

800 4800
× 36

28800
144

8|00) 1728|00

Answer 216 Acres.

Examp. 2d. in the inverſe Rule.

If 20 Men mow 36 Acres in 40 Days, in how many Days will 80 Men mow 216 Acres?

Thus:	Or thus:
A. D. A.	M. D. M.
36—40—216	20—40— 80
216	20
36) 8640	8|0) 80|0
M. D. M.	A. D. A.
20—240—80	36—10—216
20	216
8|0) 480|0	36) 2160
Anſwer 60 Days.	Anſwer 60 Days.

Or thus:

M. 20 D. 80 M.
40
A. 36 216 A.
80 20

2880 4320
× 40

2880) 172800

Anſwer 60 Days.

Or thus:

A. 36 D. 216 A.
40
M. 20 80 M.
216 36

4320 2880
40

2880) 172800

Anſwer 60 Days.

QUESTIONS.

3. If 20 Men mow 36 Acres in 40 Days, how many Men will mow 216 Acres in 60 Days? Anſwer 80 Men.

4. If 80 Men mow 216 Acres in 60 Days, how many Men will mow 36 Acres in 40 Days? Anſwer 20 Men.

5. How many Acres will 20 Men mow in 40 Days, if 80 Men mow 216 Acres in 60 Days? Anſwer 36 Acres.

6. How many Days will 20 Men require to mow 36 Acres, if 80 Men mow 216 Acres in 60 Days? Anſwer 40 Days.

Note, Every Queſtion may be thus varied ſix ways,

7. How much will 10 Men earn in 20 Days, if 30 Men earn 40 *l.* in 50 Days? Anſwer 5 *l.* 6 *s.* 8 *d.*

8. If 5 *l.* 6 *s.* 8 *d.* can be earn'd by 10 Men in 20 Days, how many Days muſt 30 Men work for 40 *l.* at the ſame Rate? Anſwer 50 Days.

9. What is the Amount of 372 *l.* 15 *s.* 10 *d.* for 4 Years, at 7 ½ *per Cent. per Annum?* Anſwer, 484 *l.* 12 *s.* 7 *d.*

And thus may the Time, Rate or Principal be found by one Stating in this Rule.

10. If a Garriſon, conſiſting of 800 Men, can ſubſiſt a Fortnight upon 20 Oxen, each weighing 5 C. how many ſuch Oxen will be neceſſary for the Garriſon 5 Weeks, when augmented by 200 Men, and what is each Man's Allowance *per* Day? Anſwer 62 ½ Oxen, at 1 ℔. of Beef *per* Day each Man.

11. If a Footman travels 120 Miles, *per* Week of 6 Days, when the (travelling) Day is 8 Hours long, in how many Days will he travel 500 Miles, when the Day is 15 Hours long? Anſwer, in 13 Days and 5 Hours.

12. How many Bricks of 9 Inches long, 4 ½ broad, and 2 ¼ thick, (incluſive of the Morter) would be ſufficient to build a Wall of 100 Feet long, 25 Feet high, and 1 ½ Brick (in Length) thick? Anſwer 53333 ⅓ Bricks.

13. If a Wall of 100 Foot long, and 25 broad, is built in 50 Days by 150 Men, how many Men (working at the ſame Rate) can build a Wall of 150 Feet long, and 30 Feet high, in 60 Days? Anſwer 225 Men.

14. If the Workmens Wages for building the former Wall amount to 937 *l.* 10 *s.* what will the Workmanſhip of the latter amount to, at the ſame Rate; and what is the weekly Wages of each Man, one with another? Anſwer, the Amount is 1687 *l.* 10 *s.* and the weekly Wages *per* Man is 15 *s.*

ALIGATION.

IN which are four Caſes, thus denominated; *viz.*

Case 1ſt, call'd Aligation medial.

Given the Quantities and Prices (or Rates) of ſeveral Things, to find the Price (or Rate) of any aſſign'd Part of the Mixture.

Case 2d, call'd Aligation alternate.

Given the Rates (or Prices) of ſeveral Things, to find the reſpective Quantities neceſſary to compoſe a Mixture, which ſhall bear any aſſign'd Rate or Price.

Case 3d, call'd Aligation partial.

Given all the Rates, one Quantity, and the mean Rate of the Mixture, to find the reſt of the Quantities ſeverally.

Case 4th, call'd Aligation total.

Given the ſeveral Rates, the total Quantity, and mean Rate of the Mixture, to find the Quantities ſeverally.

Case 1ſt.

Rule.

As the Sum of the Quantities, to the Sum of their Rates (or Prices) ſo is any Part of the Compound, to its Rate (or Price.)

Examp. 1ſt. A Grocer has Tea of 7, 8, 10 and 13*s. per* ℔; now if he mixes ½ a ℔. of the firſt, 3 ½ ℔. of the ſecond, 2 ½ ℔. of the third, and 1 ½ ℔. of the fourth Sort together, I demand the Value of 1 ℔. of the Mixture?

℔.		Prices.
½ at	7 s. =	3½ s.
3½ at	8 =	28
2½ at	10 =	25
1½ at	13 =	19½
8		8) 76 s.

Anſwer 9 s. 6 d. *per* ℔.

Case 2.

Rule.

Place the given Rates, and mean Rate as *per* Examp. and then link one Rate greater than the Mean with one leſs, till all the given Rates are link'd; then take the Difference of the mean Rate, and each of the ſeveral Rates, placing the Difference oppoſite the Yoke-fellow of the Rate concern'd; and theſe Differences are the Quantities ſought, at their reſpective oppoſite Rates.

Examp. 2. A Grocer would mix Teas of 7, 8, 10 and 13 s. *per* ℔. ſo that 1 ℔. of the Mixture may be worth 9 s. 6 d. how many ℔. of each Sort muſt there be in the Compound?

s. Thus:

$$9\tfrac{1}{2}\left\{\begin{array}{l}7\\8\\10\\13\end{array}\right.\begin{array}{l}—\ \tfrac{1}{2}\text{ at }7\,s.\\—\ 3\tfrac{1}{2}\text{ at }8\\—\ 2\tfrac{1}{2}\text{ at }10\\—\ 1\tfrac{1}{2}\text{ at }13\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

Proof 8   76 :: 1 ℔ : 9½ s.

s. Or thus:

$$9\tfrac{1}{2}\left\{\begin{array}{l}7\\8\\10\\13\end{array}\right.\begin{array}{l}—\ 3\tfrac{1}{2}\text{ ℔}\\—\ \tfrac{1}{2}\\—\ 1\tfrac{1}{2}\\—\ 2\tfrac{1}{2}\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

s. Or thus: ℔.

$$9\tfrac{1}{2}\left\{\begin{array}{r}7\\8\\10\\13\end{array}\right. \begin{array}{lllll} - & 3\frac{1}{2} & + \frac{1}{2} & = & 4\\ - & \frac{1}{2} & - & = & 0\frac{1}{2}\\ - & 2\frac{1}{2} & + 1\frac{1}{2} & = & 4\\ - & 2\frac{1}{2} & - & = & 2\frac{1}{2}\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

s. Or thus: ℔.

$$9\tfrac{1}{2}\left\{\begin{array}{r}7\\8\\10\\13\end{array}\right. \begin{array}{lllll} - & \frac{1}{2} & - & = & 0\frac{1}{2}\\ - & 3\frac{1}{2} & + \frac{1}{2} & = & 4\\ - & 2\frac{1}{2} & + 1\frac{1}{2} & = & 4\\ - & 1\frac{1}{2} & - & = & 1\frac{1}{2}\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

s. Or thus: ℔.

$$9\tfrac{1}{2}\left\{\begin{array}{r}7\\8\\10\\13\end{array}\right. \begin{array}{lllll} - & 3\frac{1}{2} & - & = & 3\frac{1}{2}\\ - & 3\frac{1}{2} & + \frac{1}{2} & = & 4\\ - & 1\frac{1}{2} & - & = & 1\frac{1}{2}\\ - & 2\frac{1}{2} & + 1\frac{1}{2} & = & 4\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

s. Or thus: ℔.

$$9\tfrac{1}{2}\left\{\begin{array}{r}7\\8\\10\\13\end{array}\right. \begin{array}{lllll} - & 3\frac{1}{2} & + \frac{1}{2} & = & 4\\ - & 3\frac{1}{2} & - & = & 3\frac{1}{2}\\ - & 2\frac{1}{2} & - & = & 2\frac{1}{2}\\ - & 3\frac{1}{2} & + 1\frac{1}{2} & = & 4\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

s. Or thus: ℔.

$$9\tfrac{1}{2}\left\{\begin{array}{r}7\\8\\10\\13\end{array}\right. \begin{array}{lllll} - & 3\frac{1}{2} & + \frac{1}{2} & = & 4\\ - & 3\frac{1}{2} & + 2 & = & 4\\ - & 2\frac{1}{2} & + 1\frac{1}{2} & = & 4\\ - & 2\frac{1}{2} & + 1\frac{1}{2} & = & 4\end{array}\left.\vphantom{\begin{array}{l}7\\8\\10\\13\end{array}}\right\}\text{Anſwer.}$$

CASE 3d.

RULE.

Find the ſeveral Quantities according to the given Rates (by Caſe 2.)

Then,

As the Quantity found (of the ſame kind with the Quantity given) to the Quantity given; ſo is any other Quantity found, to the Quantity ſought, of the ſame kind (which is no more than increaſing or decreaſing the ſeveral Quantities in any given Ratio.)

Or thus rather.

RULE 2d.

Divide the given Quantity by the Quantity found of the ſame kind; this Quote multiply'd by any other Quantity found, gives the Quantity ſought of that kind.

Note, *This is only a Contraction of the firſt Rule.*

Examp. 3. A Grocer has Teas of 7, 8, 10 and 13 *s. per* ℔. and is determin'd to mix thoſe together in ſuch ſort that he may ſell the Mixture at 9 *s.* 6 *d. per* ℔. and alſo that there ſhall be 3 ℔. of the 7 *s.* Tea in the Compound, I demand how many ℔. he muſt take of each of the other Kinds?

			Then								
		found.	found.		given.		found.		ſought.		*s.*
$9\frac{1}{2}$	7	— $\frac{1}{2}$									
	8	— $3\frac{1}{2}$	$\frac{1}{2}$	:	3	: :	$3\frac{1}{2}$	:	21	at	8
	10	— $2\frac{1}{2}$	$\frac{1}{2}$	:	3	: :	$2\frac{1}{2}$	:	15	at	10
	13	— $1\frac{1}{2}$	$\frac{1}{2}$	:	3	: :	$1\frac{1}{2}$	:	9	at	13

Or thus by Rule 2d.

$\frac{1}{2}$) 3

Quote 6

ſought.

$$\left.\begin{array}{r} \frac{1}{2} \times 6 = 3 \\ 3\frac{1}{2} \times 6 = 21 \\ 2\frac{1}{2} \times 6 = 15 \\ 1\frac{1}{2} \times 6 = 9 \end{array}\right\} \text{Anſwer, as before.}$$

CASE 4.

RULE.

Find the ſeveral Quantities at the given Rates (by Caſe 2d.)

Then,

As the Total of the Quantities found, to the total Quantity of the given Compound, ſo is each

Quantity found, to the Quantity of the ſame kind (ſought) in the Compound.

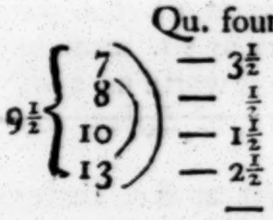
Or thus:

Rule 2d.

Divide the given Compound by the Total of the Quantities found; this Quote multiply'd by any Quantity found, gives the Quantity ſought, of that kind.

Examp. 4. A Grocer would mix Teas of 7, 8, 10 and 13 *s.* *per* ℔. ſo as that the Compound, (which he intends ſhall be 64 ℔.) may be worth 9 *s.* 6 *d.* *per* ℔. how many ℔. muſt he take of each ſort?

Or thus:



8) 64
—
Quote 8

ſought. *s.*

$3\frac{1}{2} \times 8 = 28$ at 7

$\frac{1}{2} \times 8 = 4$ at 8

$1\frac{1}{2} \times 8 = 12$ at 10

$2\frac{1}{2} \times 8 = 20$ at 13

ſought.

$8 : 64 :: 3\frac{1}{2} : 28$, &c.

And thus may every Queſtion be varied 4 ways (as Proofs.)

Questions to exerciſe all the Caſes in order.

Case 1ſt.

5. Having mix'd together 30 Gallons of Sack at 7 *s.* *per* Gallon, and 12 Gallons of *Liſbon* at 5 *s.* *per* Gallon, with 6 Gallons of Sherry at 4 *s.* 6 *d.* *per* Gallon, what is one Gallon of the Mixture worth? Anſwer 6 *s.* 2 ¼ *d.*

6. A Goldſmith has Gold of 16, 18 and 20 Carats fine, ſuppoſe he melts together a ℔. of each ſort, what Fineneſs is the Maſs? Anſwer 18 Carats fine.

7. Suppoſe he melts 3 ℔. of the firſt, 4 of the ſecond, and 5 of the third together, what is the mean Fineneſs of the Mixture? Anſwer $18\frac{1}{3}$ Carats.

8. A Cornfactor mixes together 9 Buſhels of Wheat at 8 *s.* *per* Buſhel, 6 Buſhels of Barley at 5 *s.* and 6 of Rye at 4 *s.* I demand the Value of one Buſhel of the Compound? Anſwer 6 *s.*

9. A Refiner mixes Gold of 15, 20 and 21 Carats fine; now if he melts 4 oz. of the firſt ſort, and 1 oz. of the ſecond, with 10 oz. of the third, I demand how many ℔. of Alloy he muſt add, to make the Compound 16 Carats fine? Anſwer 5 Ounces.

CASE 2d.

10. How many Gallons of Sherry at 4 *s.* 6 *d.* *per* Gallon, and *Liſbon* at 5 *s.* and Sack at 7 *s.* muſt be mix'd together, to make theCompound worth 6*s.* $2\frac{1}{4}$*d*? Anſwer $34\frac{1}{2}$ Gallons of Sack, $9\frac{3}{4}$ of *Liſbon*, and $9\frac{3}{4}$ of Sherry.

11. How many Buſhels of Wheat at 8 *s.* Barley at 5 *s.* and Rye at 4 *s.* muſt be mixt together, to make the Compound worth 6 *s.* *per* Buſhel? Anſwer 3 of Wheat, 2 of Barley, and 2 of Rye.

12. A Refiner mixes Gold of 15, 20, 21 Carats fine, and having melted theſe together with a certain Quantity of Alloy, finds the Compound to be 16 Carats fine, I demand how much he took of each ſort of Gold, and how much Alloy? Anſwer 5 oz. of 15 Cartas fine, 16 of 20, 1 of 21, and 4 oz. of Alloy.

13. Suppoſing every thing as in the 10th, except that it is requir'd to mix but 2 Gallons of Sherry, how much Sack and *Liſbon* muſt then be in the Compound? Anſwer 10 Gallons of Sack, and 4 of *Liſbon*.

14. How much Barley at 5 *s.* and Rye at 4 *s.* muſt be mixt with $10\frac{1}{2}$ Buſh. of Wheat at 8 *s.* to make the Compound worth 6 *s.* *per* Buſh. Anſ. 7 Buſh. of each.

15. Suppoſe in the 12th Queſtion there were 12 oz. of Alloy in the Mixture, how much of each ſort of Gold muſt then be in the Compound to make it 16 Carats fine? Anſwer 15 oz. of 15 Carats fine, 48 of 20, and 3 of 21.

CASE 4th.

16. Suppoſe in Queſtion 10 it were requir'd to make the total Compound contain 5 Tons, 1 Hhd. 13 ½ Gall. how many Gallons of each Sort muſt there be in the Compound? Anſwer 138 of Sack, 39 of *Liſbon*, and 39 of Sherry.

17. How much Gold of 15, 20 and 21 Carats fine, and Alloy muſt be mixt together, ſo that the Compound may be 3 ℔. 3 oz. of 16 oz. fine? Anſwer 6 oz. of 15, 1 ½ of 20, 24 of 21, and 7 ½ oz. of Alloy.

18. How much Wheat at 8 *s.* and Barley at 5 *s.* and Rye at 4 *s.* muſt be mixt together, to make a Compound of 35 Buſhels worth 10 *l.* 10 *s*? Anſwer 15 of Wheat, 10 of Barley, and 10 of Rye.

SINGLE FALSE POSITION.

THIS Rule is called falſe Poſition, becauſe by a falſe Number, the true Number is found.

RULE.

Suppoſe any Number to be the Number ſought, and therewith proceed according to the Queſtion; then as this Reſult to the ſuppos'd Number, ſo is the given Reſult to the true Number ſought.

That is,

As falſe Reſult to falſe Number, ſo is true Reſult to true Number.

Examp. What Principal, being put to Intereſt for 7 Years, and 6 Months, at 4 *per Cent. per Annum*, will amount 484 *l.* 12 *s.* 7 *d?*

Suppoſe the Principal ſought to be—

— 10 *l.*

× 30 = $7\frac{1}{2}$ × 4

Intereſt = 3|00

Princ. = 10

— Sup.N. true Reſult.

Reſult 13 : 10 :: 484 12 7

20

9692

12

13) 1163110 (89470

745 | 5 *s.* 10 *d.*

Anſwer 372 15 *s.* 10 *d.*

2. Three Perſons diſcourſing of their Ages, ſays *B*, I am as old, and $\frac{1}{3}$ as old as *A*, and $\frac{1}{2}$ as old as *C*, I demand the Ages of *A*, *B*, *C* ſeverally, allowing the Sum of their Ages to be 75? Anſwer *A* 15, *B* 20, and *C* 40.

3. Three Merchants gain 360 *l.* at the Rate of 20 *per Cent*. *B*'s Stock is double to *A*'s, and *C*'s is triple of *B*'s, I demand each Man's Stock and Gain? Anſwer *A*'s Stock is 200 and Gain 40, *B*'s 400 and 80, and *C*'s 1200 and 240.

4. What Number is that whoſe $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ and $\frac{1}{6}$ make 19? Anſwer 20.

5. What Sum will amount to 75 *l.* in 10 Years, at 5 *per Cent. per Annum?* Anſwer 50 *l.*

6. Bought 20 Yards of Velvet, 30 Yards of ſuperfine Cloth, and 10 Yards of coarſe Cloth for 76 *l.*

76 *l.* 16 *s.* now if 1 Yard of Velvet coſts as much as 3 Yards of fine Cloth, and a *Flemiſh* Ell of fine Cloth coſts as much as an *Engliſh* Ell of coarſe, I demand the Price of each Sort *per* Yard? Anſwer, Velvet 2 *l.* 8 *s.* fine Cloth 16 *s.* and coarſe 9 *s.* $7\frac{1}{5}$ *d.* *per* Yard.

7. *Tipling Tom* drinks a Caſk of Beer in 6 Days; his loving Wife *Brandy-fac'd Nan* drinks the ſame in 5 Days, and her dutiful Daughter *Sweet Miſs Jenny*, with the help of her Lad *Clodpate*, drinks it in 4 Days; now if they all drink together at a double Rate, I demand in what Time they will empty the Caſk, allowing the Length of their Drinking-day to be 14 Hours, 48 Minutes? Anſwer 1 Day, 8 Hours, $49\frac{23}{37}$ Minutes.

8. A Ciſtern has three Cocks, *A*, *B*, *C*, by the Cock *A* it can be empty'd in 4 Hours, by *B* it can be empty'd in 3 Hours, by the Cock *C* (at the Top) $\frac{3}{4}$ of the Ciſtern can be fill'd in $\frac{1}{2}$ an Hour, I demand in what Time the Ciſtern will be fill'd, if all the Cocks are ſupply'd, and running together? Anſwer in 1 Hour and $5\frac{5}{11}$ Minutes.

9. A Drover being aſk'd how many Sheep he had bought, and how many he had ſold that Day, anſwer'd thus—The $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{4}{5}$ leſs 1 of the Number I have ſold, is equal to $\frac{5}{6}$ of the Number I bought, I demand how many Sheep he had left unſold of that Day's Purchaſe? Anſwer 28, for he bought 48, and ſold 20.

Note, *This Queſtion admits of an infinite Number of Anſwers.*

10. A Drover who took 121 Sheep to Market, being aſk'd how many he had ſold, anſwer'd, on *Monday* I ſold $\frac{1}{2}$, on *Tueſday* $\frac{2}{3}$, on *Wedneſday* $\frac{5}{7}$ of the Number I have left, I demand at what Rate *per* Sheep I muſt buy the Remainder to gain $\frac{1}{4}$ of the prime Coſt, by ſelling them for 63 *l.* Anſwer 24 *s.*

11.

11. A Gameſter loſes at five Games of Billiards 93 Crowns, having play'd every Game double or quit, I demand his laſt Bet? Anſwer 12 *l.*

DOUBLE FALSE POSITION.

THIS is call'd double Poſition, becauſe the Queſtion is ſolv'd by two Suppoſitions.

RULE.

1ſt, Take any Number, and try if it will anſwer the Conditions of the Queſtion; if not, find the Difference of this Reſult, and the true Reſult; and if the falſe Reſult is too great, mark the Error with the Sign Plus +; if 'tis too little, mark the Error with Minus —.

2d, Suppoſe any other the true Number, and work with it as before, marking the Errors, according as they are too much or too little.

3. Multiply each Poſition by the Error of the other Poſition, and if the Errors where alike (both + or both —) divide the Difference of the Products by the Difference of the Errors; but if the Errors are unlike (*viz.* one + the other —) divide the Sum of the Products by the Sum of the Errors, the Quote (in either Caſe) is the true Number ſought.

Or thus (having found the Errors.)

RULE 2d.

As the Sum of the Errors, if unlike, or Difference, if alike, to the Difference of the Poſitions, ſo is either Error to a fourth Number; which added to, or ſubtracted from its Poſition, according as the Poſition was too little or too much, gives the true Number ſought.

Examp. *Tom* aſk'd *Dick* to lend him 100 Guineas; ſays *Dick* I have not ſo many, but if I had triple as many as I have, leſs 20, I ſhould then have juſt the Sum you require; how many Guineas had *Dick*?

G.	G.
1ſt Sup. 12	2d Sup. 30
× 3	× 3
36	90
— 20	— 20
— 16	— 70
Should be 100	Should be 100
Error — 84	Error — 30
Poſition 12	30 Poſition.
360	2520

84 2520
— 30 — 360

54) 2160

Anſwer 40 Guineas.

Or thus:

G. G.
1ſt Sup. 12 2d Sup. 50
3 3
36 150
— 20 — 20
16 130
Should be 100 Should be — 100
Error — 84 Error + 30

12 50
360 84 4200
30 + 360
114) 4560
Anſwer 40 Guineas,

By RULE 2d.

Errors { 84 30
— 30 12
Error.
Difference 54 : 18 :: 84
9) 2 14
14
+ 28 = 4th Number.
Poſition = 12
Anſwer 40

Of

Or thus:

Errors { 84 — 30
{ − 30 — 12

Difference 54 : 18 :: Error. 30

9) 2 5

5

+ 10 = 4th Number.

Poſition = 30

Anſwer 40

Or thus:

Errors { 84 — 50
{ + 30 — 12

Sum = 114 : 38 :: Error. 84

19 2 14

14

+ 28 = 4th Number.

Poſition = 12

Anſwer 40

Or thus:

Errors { 84 — 50
{ + 30 — 12

Sum = 114 : 38 :: Error. 30

19) 2 5

× 5

− 10 = 4th Number.

Poſition = 50

Anſwer 40

Having caught a Fiſh, whoſe Head is 7 Feet long; I find the Tail is as long as the Head and ½ the Body, and the Body as long as the Head and Tail, I demand the intire Length of the Fiſh?

Sup. Tail	= 19	Sup. Tail	= 11
Head	= 7	Head	= 7
The Body	= 26	The Body	= 18
And ½ Body	= 13	And ½ Body	= 9
Head	= 7	Head	= 7
Tail	= 20	Tail	= 16
Should be	= 19	Should be	= 11
	— 1		— 5
	19		11
	95		11

5	95
— 1	— 11
4	) 84

True Tail = 21
Head = 7

½ Body = 14
Body = 28

Proof.

Body = 28 = Head and Tail = 7 + 21.
Tail = 21 = Head and ½ Body = 7 + 14.
Head = 7

Anſwer 56 Feet, the Length of the Fiſh.

QUESTIONS.

QUESTIONS.

3. *A* aſk'd *B* to lend him the 100 Crowns he had in his Pocket; ſays *B*, I find you are no Conjurer, for the $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ of the Money I have makes but 52 Crowns; now tell me how many I have, and take them; ſays *A*, you have 48 Crowns. Anſwer, right.

4. Two Men ſet out from different Towns at 10 a-Clock in the Forenoon, and meeting at 2 in the Afternoon, *B* tells *A*, that if he had tripl'd his Pace he ſhould have walk'd at the Rate of 13 Miles an Hour; then ſays *A*, I find I have travell'd $\frac{1}{2}$ as far as you, I demand the Diſtance of the Towns? Anſwer 26 Miles.

5. A Maſter-bricklayer hires a tippling Journeyman on theſe Terms, *viz.* the Journeyman to have 3 *s.* 6 *d.* for every Day he work'd, and to refund 1 *s.* for every Day he idled; at the End of 45 Days they ſettle Accounts, and neither Party receives any Money; the Queſtion is, how many Days the Journeyman work'd, and how many he idled? Anſwer, he work'd 10 Days, and idled 35.

6. Suppoſing, in the above Caſe, that the Journeyman had receiv'd 5 *l.* 12 *s.* 6 *d.* how many Days muſt he then have wrought and idled? Anſwer, juſt the reverſe of the former.

7. *Bob*, and his Wife *Beſs*, having eat $\frac{1}{2}$ a hundred (or 50) Oyſters, could not agree about the reſpective Numbers eaten; but this *Bob* knew, that if his Number were divided by his Wife's, and his Wife's by his, then quadruple the former Quote would be equal to 9 times the latter. Requir'd the Numbers? Anſwer, *Bob* eat 30, and *Beſs* 20.

8. Three Merchants, by a Joint-ſtock, gain 819 *l.* at the Rate of 27 *per Cent.* now if $\frac{1}{3}$ of *A*'s Gain is equal to 3 times *C*'s, and $\frac{1}{3}$ of *B*'s Stock is equal to the triple of *A*'s Stock, I demand each Man's Stock? Anſwer, *A* 300 *l.* *B* 2700 *l.* *C* 33 *l.* 6 *s.* 8 *d.*

9. There are two Towns 50 Miles aſunder, out of the one *Jeremy* departs to viſit his loving Wife *Joan* in the other; but ſhe, dear Creature, ſets out to meet him, and immediately diſpatches an Expreſs to inform him, that if he call'd at a certain Caſcade on the Road, he would there find his perpetual Repeter drinking his Health in a Bumper of Gin; now if when *Jeremy* and the Meſſenger meet, *Joan* is lodg'd in the Gin-ſhop at 5 Miles Diſtance, I demand how many Miles each have travel'd, if $\frac{1}{2}$ the Diſtance travel'd by *Jeremy* is equal to double the Diſtance travel'd by *Joan?* Anſwer, *Jeremy* travel'd 36 Miles, and *Joan* 9.

10. *A* and *B* diſcourſing of their Money; ſays *A* to *B*, if you give me 5 *s.* I ſhall have double as many Shillings as you will have left; nay, ſays *B*, but if you give me double the Sum you aſk, 'twill be juſt the ſame as if we chang'd Purſes, how many Shillings had each? Anſwer, *A* 35, and *B* 25.

11. I having cut off $\frac{1}{3} + 6$ Feet of a Tree in my Garden, find there remains ſtanding only $\frac{1}{2} - 2$ Feet, I demand the entire Length of the Tree? Anſwer, 24 Feet.

12. *Tom*, *Dick*, and *Roger* being in Company pay thus; *Tom* and *Dick* 5 *s.* 10 *d.* *Dick* and *Roger* 7 *s.* 6. and *Roger* and *Tom* 6 *s.* 8 *d.* how much did each pay? Anſwer, *Tom* 2 *s.* 6 *d.* *Dick* 3 *s.* 4 *d.* and *Roger* 4 *s.* 2 *d.*

13. *A* and *B* depart from a certain Town at the ſame Time, and travel the ſame Road; but *A* travels 12 Miles every Day; and *B* only 1 Mile the 1ſt Day, 3 the next, 5 the next, and ſo on, increaſing 2 Miles every Day. I demand in how many Days *B* will overtake *A?* Anſwer 12 Days.

14. I being aſk'd my Age by Miſs *Pert*; to avoid a direct Anſwer, reply'd thus: The Product of $\frac{1}{5}$ of my Age by $\frac{1}{6}$ of the ſame, and that Product by $\frac{1}{10}$ of my Age is 90 Years.—And now, Madam, I ſhall leave

you to determine my Age, as I am unſkill'd in Numbers. Anſwer 30 Years.

VULGAR FRACTIONS.

A Fraction (as $\frac{3}{4}$) conſiſts of two Terms, *viz.* the Numerator (or upper Number) and the Denominator (or under Number) the Denominator ſhews how many equal Parts the Integer is divided into, and the Numerator ſhews how many of thoſe Parts are expreſs'd by the Fraction; for example, in $\frac{3}{4}$ of a Foot the Denominator 4 ſhews, that the Foot is (ſuppos'd) divided into 4 equal Parts; and the Numerator 3 ſhews, that we are to take 3 of thoſe Parts, for the Value of the Fraction $=$ 9 Inches. A Fraction is either proper or improper, ſimple or compound; a Fraction, in a ſtrict and proper Senſe, repreſents a Part of a whole Thing; and conſequently, when the Numerator is equal to, or greater than the Denominator, this is an improper Fraction (or improperly call'd a Fraction) as $\frac{4}{4}$ or $\frac{4}{3}$ of a Foot, for $\frac{4}{4}$ is equal to the whole Foot, and therefore is no Part thereof; and $\frac{4}{3}$ is equal to a whole Foot and $\frac{1}{3}$ of a Foot, and conſequently being more than the Whole, cannot be (properly) call'd a Part thereof; and univerſally, when the Numerator is leſs than the Denominator, the Fraction is leſs than 1; when 'tis equal to the Denominator, the Fraction is equal to 1; when 'tis greater, the Fraction is greater than 1.—A ſimple Fraction is a Fraction immediately referr'd to the Integer, as $\frac{3}{4}$ of a *l.* $=$ 15 *s.*—A compound Fraction is a Fraction of a Fraction, as $\frac{2}{5}$ of $\frac{3}{4}$ of a *l.* $= \frac{2}{5}$ of 15 *s.* $=$ 6 *s.*

1ſt. To reduce different Denominations to a Fraction of an Unit of the higheſt Denomination.

RULE.

Reduce the different Denominations to one Denomination for a Numerator, and reduce the Integer to the ſame Denomination for the Denominator.

Examp. 1ſt. Reduce 15 *s.* 6 *d.* to a Fraction of a Pound.

l. *s.* *d.* Or thus:
1 15 6 15 2
× 240 12 2
Anſwer $\frac{186}{240}$ *l.* Anſwer $\frac{31}{40}$ *l.*

Reduce 15 *s.* 6 *d.* to a Fraction of a Guinea.
12
21 *s.* Or thus:
12 $\frac{186}{252}$ G. $15\frac{1}{2}$
252 $\frac{31}{42}$ G.

Examp. 2d. Reduce 15 *s.* 6 *d.* to a Fraction of a Shilling and of a Penny. 12

$15\frac{1}{2}$ Anſw. $\frac{186}{1}$ *d.* both improper Fract.
Anſwer $\frac{31}{2}$ *s.*

2d. *To find the Value of a Fraction.*

RULE.

Multiply the Numerator by the Value of the Integer in the next inferior Denomination, and divide by the Denominator; and again multiply the Remainder (if any) by the Value of an Unit of the (laſt) Multiplier in the next lower Denomination, and ſo on; the Denominations of the ſeveral Quotes are the ſame as thoſe of the reſpective Multipliers, and the laſt Remainder being made the Numerator of a Fraction (of the laſt Denomination) whoſe Denominator

nominator is the Diviſor; then this Fraction, added to the Sum of the Quotes, gives the Value of the given Fraction.

Examp. 3d. What is the Value of $\frac{31}{40}$ *l.* in *s.* &c?

31
× 20 *s.* = 1 *l.*
40) 620 (15 *s.*
220
20 *s.*
× 12 *d.*
4|0) 24|0 (6 *d.*

Or thus:
20) 40 (2) 31
Anſwer 15 6

Anſwer 15 *s.* 6 *d.*

Examp. 4th. Reduce $\frac{373}{480}$ *l.* to *s.* &c.

373
20 *s.* = 1 *l.*
48|0) 746|0 (15 *s.*
266
26 *s.*
12
48) 312 (6 *d.*
$\frac{24}{48} = \frac{1}{2}$

Anſwer 15 *s.* 6½ *d.*

Examp. 5th. Reduce $\frac{480}{373}$ *l.* to *l. s.* &c.

373) 480 (1 *l.*
107
× 20
2140 (5 *s.*
275
× 12
3300 (8 *d.*
316
373

Or thus:
480
20
373) 9600
Anſwer $25\frac{275}{373}$ *s.*

Anſwer 1 *l.* 5 *s.* 8 *d.* $\frac{316}{373}$.

To reduce an improper Fraction to a mixt Number.

RULE.

Divide the Numerator by the Denominator, the Quote is a whole Number; to which annexing the Fraction (if there is any Remainder) you have the compleat Value in a mixt Number.

Examp. Reduce $\frac{34}{5}$ ℔. to a mixt Number.

5) 34

Anſwer $6\frac{4}{5}$ ℔.

To change any given Fraction into another equivalent Fraction, that ſhall have any aſſign'd Numerator or Denominator.

RULE.

CASE 1ſt. If the aſſign'd Term is greater than its Correſpondent in the given Fraction,

Divide the aſſign'd Term by its correſponding Term in the given Fraction, the other Term of the given Fraction being multiplied by this Quote, the Product is the Term ſought.

CASE 2d. If the aſſign'd Term is leſs than its Correſpondent,

Divide the correſponding given Term by the aſſign'd Term, the other given Term divided by this Quote quotes the Term ſought.

Examp. 1ſt. Reduce $\frac{3}{4}$ to an equivalent Fraction, whoſe Numerator ſhall be 6.

3) 6
—
Anſwer $\frac{6}{8}$. × 2
4
—
8 Denominator ſought.

Examp. 2d. Reduce $\frac{6}{8}$ to an equivalent Fraction, whoſe Denominator ſhall be 4.

4) 8
—
Anſwer $\frac{3}{4}$. 2) 6
—
3 Numerator ſought.

Note, *'Tis proper that the aſſign'd Term be either a Multiple, or an aliquot Part of its correſponding Term in the given Fraction.*

To reduce a given Fraction to its loweſt Terms.

RULE.

Divide the greater Term of the given Fraction by the leſſer, and then proceed, continually dividing the laſt Diviſor by the laſt Remainder, till 0 remains; the laſt Diviſor is the greateſt common Diviſor, by which, if you divide the Terms of the given Fraction ſeverally, the Quotes are the Terms of the Fraction ſought.

Note, *If* 1 *be the laſt Diviſor, 'tis evident that the given Fraction is already in its loweſt Terms.*

Examp. Reduce $\frac{36}{96}$ to its loweſt Terms.

$12)\frac{36}{96}|\frac{3}{8}$ Anſ.

```
36) 96 ( 2
    24 ) 36 ( 1
         12 ) 24 ( 2
               0
```

Here 12 is the greateſt common Meaſure, and $\frac{36}{96}$ in its loweſt Terms is $\frac{3}{8}$.

To reduce Fractions, having unlike Denominators, to equivalent Fractions that ſhall have like Denominators.

RULE.

Multiply each given Numerator by every Denominator, except its own, for a new Numerator, inſtead of that us'd.

And take the continual Product of all the given Denominators for a common Denominator.

Examp. Reduce $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{7}{8}$ to a common Denominator.

3	5	7	4
6	4	6	6
18	20	42	24
8	8	4	8
Num. 144	Num. 160	Num. 168	192 Deno.

Anſw. $\frac{144}{192}$ $(=\frac{3}{4})$; and $\frac{160}{192}$ $(=\frac{5}{6})$; and $\frac{168}{192}$ $(=\frac{7}{8}.)$

Note, *When Fractions are to be added or ſubtracted, they muſt be reduc'd to a common Denominator; but 'tis not neceſſary in any other Caſe.*

ADDITION.

RULE.

Your given Fractions being reduc'd to like Denominators, if they are unlike; to the Sum of the Numerators ſubſcribe the common Denominator, this Fraction is the Sum required.

Examp. Add $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{7}{8}$ into one Sum.

Reduc'd $\frac{144}{192}$, $\frac{160}{192}$, $\frac{168}{192}$

$$\left.\begin{array}{r} 144 \\ 160 \\ 168 \end{array}\right\} \text{Num}^{s}.$$

$$\text{Sum} = \frac{472}{192} = 2\tfrac{11}{24}.$$

SUBTRACTION.

RULE.

Your Fractions being reduc'd to like Denominators, if they are unlike; to the Difference of the Numerators, ſubſcribe the common Denominator, this Fraction is the Difference ſought.

Examp. From $\frac{5}{6}$ take $\frac{3}{4}$.

$$\frac{5}{6} = \frac{20}{24}$$
$$\frac{3}{4} = \frac{18}{24}$$

Anſw. $\frac{2}{24} = \frac{1}{12}$.

From $2\frac{3}{4}$ take $\frac{5}{6}$.

thus.

$$\begin{array}{r} 2\frac{18}{24} \\ -\,0\frac{20}{24} \\ \hline \end{array}$$

Anſwer $1\frac{22}{24}$

or thus.

$$\begin{array}{r} 18 \\ 24 \\ \hline 1\frac{42}{24} \\ -\,0\frac{20}{24} \\ \hline \end{array}$$

Anſwer $1\frac{22}{24} = 1\frac{11}{12}$

MULTIPLICATION.

RULE.

The continual Product of all the Numerators is the Numerator ſought, and the continual Product of all the Denominators is the Denominator ſought.

Examp. Reduce $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of a *l.* to a ſimple Fraction.

3	4
5	6
15	24
7	8
Numerator 105	192 Denominator.

Anſwer $\frac{105}{192}$ *l.* = $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of a *l.*

DIVISION.

RULE.

Invert your Diviſor, and then the Product of the Diviſor and Dividend is the Quotient ſought.

Examp. Divide $\frac{3}{4}$ by $\frac{5}{6}$.

$\frac{6}{5} \times \frac{3}{4} = \frac{18}{20} = \frac{9}{10}$ Anſwer.

To apply Fractions in the Rule of Three direct.

RULE.

Invert the firſt Terms, and then the Product of the three given Terms is the 4th Term ſought.

DECIMAL FRACTIONS.

A Decimal Fraction is a Fraction whoſe Denominator is always 10, or ſome Power of 10, as 10, or 100, or 1000, &c. and the Number of 0's is always equal to the Number of Places in the Numerator; hence the Numerator being known, the Denominator is alſo known, and therefore never ſet down,

D. V. D. V. D. V.
viz. $25 = \frac{25}{100}$, and $250 = \frac{25}{100}$, and $025 = \frac{25}{1000}$.

Hence, as 0's prefixt before whole Numbers have no Effect, ſo 0's annext to Decimals have no Effect; and as 0's annext to whole Numbers increaſe their Value, ſo 0's prefixt before Decimals decreaſe their Value in the ſame Proportion; and as the Value of whole Numbers decreaſeth from left to right, ſo does the Value of Decimals.

This Decimal 25 is read thus, two tenths, and five hundredths; or thus, 25 hundredth Parts; and ſo of any other.

To reduce a Vulgar Fraction to a Decimal.

RULE.

To the Numerator annex as many 0's as you would have Places in the Decimal; then divide this increas'd Numerator by the Denominator, and the Quote is the Decimal equivalent thereto.

Examp. 1ſt. Reduce $\frac{3}{4}$ to a Decimal.

4) 300

Anſwer 75 Decimal ſought.

Examp. 2d. Reduce $\frac{2}{7}$ to a Decimal.

7) 20000000 (

Anſwer, 2857142 the Decimal ſought.

Here the Decimal appears to be a circulate, and therefore the true Value of this vulgar Fraction cannot poſſibly be expreſſed decimally, but 4 or 5 Decimals are generally ſufficient.

ADDITION.

RULE.

Let all Figures, having like Places, fall into one Column; and having added, as in Addition of whole Numbers, point off as many for Decimals in the Sum, as the greateſt Number of Decimals in any one of the given Sums.

Examp. Add ,452 + ,63, + ,6245.

$$\text{Add}\left\{\begin{array}{r},452\\,63\\,6245\end{array}\right. \qquad \text{Add}\left\{\begin{array}{r}4,062\\0,076\\47,3\end{array}\right.$$

Sum 1,7065 Sum 51,438

SUBTRACTION.

RULE.

Place your given Numbers as directed in Addition, and having ſubtracted as in whole Numbers, point off as many for Decimals in the Remainder, as the greateſt Number of Decimals in either given Line.

Examp. 1ſt. From 47,3 take 4,062.

4,062

Remainder 43,238

Examp. 2d. From 47,3 take ,63.
63

Remainder 46,67

MULTIPLICATION.

RULE.

Multiply as in whole Numbers, and point off as many for Decimals in the Product, as there are Decimals in both Factors.

Examp. 1ſt. Multiply 47,3 by ,63.

47,3
,63

1419
2838

Product 29,799

Examp. 2d. ,4526
,0063

13578
27156

,00285138 Product.

DIVISION.

RULE.

The Number of decimal Places in both Diviſor and Quote, muſt be equal to the Number of decimal Places in the Dividend.

Note, *This is only a plain Conſequence of the Rule for Multiplication, the Diviſor and Quote being two Factors, whoſe Product is the Dividend.*

Examp. ,63) 29,799 (47,3
459
189

,4526) ,00285138 (63 Quote.
13578.

But the true Quote is 0063.

INFINITE DECIMALS.

DEFINITIONS.

1ſt. A Finite Decimal is ſuch as has a determinate or aſſignable Number of Places, as ,25 ($=\frac{1}{4}$.)

2d. A certain infinite Decimal is ſuch, whoſe Number of Figures may be continually increas'd by a conſtant Repetition of the ſame Figure or Figures, as ,1666, &c. ($=\frac{1}{6}$) or ,2727, &c. ($=\frac{3}{11}$) in the firſt 6 is continually repeated, and in the ſecond 27 is continually repeated; hence theſe are called circulating Decimals, and the Figure or Figures repeated are called the Circle or Repetend; when one Figure is continually repeated 'tis called a ſingle Repetend, and the repeting Figure is mark'd with a Daſh thus, $1\acute{6}$, to diſtinguiſh it from the other Figures which do not repete, and are therefore called the finite Part of the Circulate; ſo in the firſt Example $,1\acute{6}$ is a circulate, 1 is the finite Part, and $\acute{6}$ is the Circle or ſingle Repetend; and this is called a mixt Circulate, becauſe it has a ſignificant finite Part.

3d. In the ſecond Example ,27 is the Repetend, and is called a compound Repetend, becauſe there are more than one Figure in the Circle (or Repetend) and is call'd a pure Circulate, becauſe it has no (ſignificant) Finite, mark'd thus, $,\acute{2}\acute{7}$, alſo $,0\acute{2}\acute{7}$ is a pure Circulate.

4th. An uncertain infinite Decimal is an infinite Decimal having no continual Repetition of the ſame Figure or Figures, as ,7258, &c. ($=\frac{45}{62}$), and this is called an approximate (or an approximating Decimal), becauſe we are oblig'd to take its imperfect

Value by Approximation, which we may alſo conveniently do in Decimals, which would circulate if they were far enough continued, when the Circulation does not appear in 8 or 9 Figures.

5th. Similar Circulates are ſuch, whoſe Repetends conſiſt of the ſame Number of Places, and begin at the ſame Diſtance from the decimal Point, ſo $,41\dot{6}$ and $,58\dot{3}$ are ſimilar Circulates, for each Repetend contains one Figure, and the Circulation begins in both at the third Place from the decimal Point; in like manner $,\dot{1}4285\dot{7}$ and $,\dot{8}5714\dot{2}$ are ſimilar Circulates, but $,1\dot{6}$ and $,\dot{3}$ are diſſimilar Circulates; for the firſt begins at the ſecond Place after the decimal Point, and the other at the firſt Place, and ſo are $,\dot{2}\dot{7}$ and $\dot{1}4285\dot{7}$ diſſimilar Circulates; for though they both begin at the ſame Diſtance from the decimal Point, yet they have not an equal Number of Places in their Repetends.

6th. Any Repetend may be changed into another Equivalent, beginning at any greater aſſign'd Diſtance from the decimal Point, having the ſame Number of Places as the given Repetend, by repeating as many Figures of the given Repetend as you have added Places to the finite Part.

Examp. Change the mixt Circulate $,41\dot{6}$ into an equivalent Circulate, whoſe Repetend ſhall conſiſt of one Figure, and begin at the fourth Place from the decimal Point.

Anſwer $,416\dot{6}$ ($=$ $,41\dot{6}$.

Examp. 2. Change the pure Circulate $,\dot{1}4285\dot{7}$ into an equivalent mixt Circulate, whoſe finite Part ſhall have two Places, and Repetend ſix.

Anſwer $,14\dot{2}8571\dot{4}$.

From the laſt Particular 'tis plain, that we may change any Circulate having a ſingle Repetend, into an equivalent Circulate having a compound Repetend, conſiſting of any aſſign'd Number of Places, and beginning at (the ſame or) any aſſign'd greater Number of Places from the decimal Point, by removing the repeating Point to the Place aſſign'd, and repeating the Repetend as oft as neceſſary.

Examp. Change the Circulate $,41\dot{6}$ into an equivalent Circulate, having three Places in the finite Part, and four Places in the Repetend. Anſwer $,416\dot{6}66\dot{6}$.

But tho' the repeating Point of a compound Repetend (of different Figures) may be remov'd to any aſſign'd greater Diſtance from the decimal Point, yet the Repetend muſt always conſiſt of the ſame Number of Places, or ſome Multiple thereof.

Examp. Change the compound Repetend $\dot{1}4285\dot{7}$ into another Repetend, beginning at the third decimal Place, and having twelve Places.

Anſwer $,14\dot{2}8571428571\dot{4}$.

But if it were requir'd to change it, ſo as the new Repetend ſhould have four Places (as $,14\dot{2}85\dot{7}$) or 8 Places (as $14\dot{2}871428\dot{7}$), the thing is impoſſible, becauſe neither 4 nor 8 is a Multiple of 6, the Number of Places in the given Repetend, and ſo neither $\dot{2}85\dot{7}$ nor $\dot{2}871428\dot{7}$ is a Circle.

From what has been ſaid, we may eaſily deduce a Rule for changing any Number of diſſimilar Circulates into equivalent ſimilar Circulates, that is, Circulates whoſe Repetends have all the ſame Number of Places, and begin at the ſame Diſtance from the decimal Point.

RULE.

Find the leaſt common Multiple of the ſeveral Numbers of Places in the given Repetends, and this will be the Number of Places that each of the new Repetends muſt have; and they muſt all begin at the ſame Diſtance from the decimal Point, as the laſt Place of the longeſt given Finite.

Ex. given.	reduc'd.	
$\frac{5}{12} = 41\dot{6}$	$= 0,41\dot{6}6666\dot{6}$	Here the leaſt common Multiple is 6.
$\frac{14}{27} = ,\dot{5}1\dot{8}$	$= 0,51\dot{8}5185\dot{1}$	
$4\frac{2}{11} = 4,\dot{1}\dot{8}$	$= 4,18\dot{1}8181\dot{8}$	
$\frac{1}{7} = ,\dot{1}4285\dot{7}$	$= 0,14\dot{2}8571\dot{4}$	

Note, *A Circle may begin in the integral (as well as decimal) Part of a Circulate, as* $\dot{6}, \dot{6}$, *or* $6\dot{6}, \dot{6}$; *or* $\dot{6}6, \dot{6}$, *or* $\dot{4}, 2\dot{3}$, &c. $(= 4, \dot{2}3\dot{4})$ *and this is a mixt Circulate, whoſe finite Value is found by taking as many 9's for the Demoninator as there are Places in the Circle, whoſe Numerator is the Circle, with as many 0's to the right as there are integral Places in the given Circle; hence* $\dot{6}, \dot{6} = \frac{660}{99}$, *and* $4,2\dot{3} = \frac{4230}{999}$.

CASE I. *To find the finite Value of a pure Circulate.*

RULE.

Take a vulgar Fraction, whoſe Numerator is the Repetend, and the Denominator as many 9's as there are Places in the Repetend, with as many 0's to the right as there are Places betwixt the decimal Point, and the Repetend; hence $\frac{1}{3} = \frac{3}{9}$, and $,00\dot{3} = \frac{3}{900}$; and $,\dot{2}\dot{7} = \frac{27}{99}$, and $,\dot{5}1\dot{8} = \frac{518}{999}$.

CASE 2. *To find the finite Value of a mixt Circulate.*

RULE.

Multiply the finite Part (incluſive of the integral Part, if any) by as many 9's as there are Places in the Repetend, to which Product add the Repetend, the Sum is the Numerator of a vulgar Fraction, whoſe Denominator is that of the finite Part (found by Caſe 1ſt) and this vulgar Fraction is the finite Value of the given Circulate.

Examp. Requir'd the finite Value of $4{,}\dot{5}1\dot{8}$.

$$\begin{array}{r} 999 \\ \times 4 \\ \hline 3996 \\ +518 \\ \hline \text{Num. } 4514 \end{array} \qquad \text{Anſwer } \frac{4514}{999}.$$

Requir'd the finite Value of $,41\dot{6}$.

$$\begin{array}{r} ,41\dot{6} \\ \times 9 \\ \hline \end{array}$$

Anſwer 375.

Requir'd the finite Value of $46{,}08\dot{3}$.

$$\begin{array}{r} 46{,}08\dot{3} \\ \times 9 \\ \hline \end{array}$$

Anſwer $\frac{41475}{900}$.

Or thus:

$$\begin{array}{r} ,08 \\ \times 9 + 3 \\ \hline \end{array}$$

Anſwer 46 + $\frac{75}{\text{[illegible]}}$.

ADDI-

ADDITION.

RULE.

Make them all ſimilar, and divide the Sum of the Repetends by their common Denominator, put the Remainder down for the Repetend of the Sum, and carry the Quote to the Finite, which is added as in common.

Diſſimilar. Similar.

$$\text{Add}\begin{cases} {,}41\dot{6} &= 0{,}41\dot{6}66666\dot{6} \\ {,}\dot{5}1\dot{8} &= 0{,}51\dot{8}5185\dot{1} \\ 4{,}\dot{1}\dot{8} &= 4{,}18\dot{1}8181\dot{8} \\ \dot{1}4285\dot{7} &= \underline{0{,}14\dot{2}8571\dot{4}} \end{cases}$$

999999) 1986049) 1 to carry to the Finite.

Sum requir'd $= 5{,}25\dot{9}8605\dot{0}$.

SUBTRACTION.

RULE.

Having made the Subtractor and Subtrahend ſimilar, if the Repetend of the Subtractor, is equal to or leſs than the Repetend of the Subtrahend, then ſubtract as in common.

But if the Repetend of the Subtractor exceeds that of the Subtrahend, add 1 to the right-hand Figure of the Repetend of the Subtractor, and then ſubtract as in common.

Examp. 1ſt. $7{,}51\dot{8}5\dot{1}$

$\underline{{,}41\dot{6}6\dot{6}}$

Remaind. $= 7{,}10\dot{1}8\dot{5}$

Examp. 2d. $7{,}41\dot{6}6\dot{6}$

$\underline{{,}51\dot{8}5\dot{1}}$

$6{,}89\dot{8}1\dot{4}$

MUL.

MULTIPLICATION.

RULE.

Find the finite Values of both Factors, which Values being vulgar Fractions, their Product is ſound by Multiplication of vulgar Fractions, and this is the Product ſought in a vulgar Fraction; but if you require it decimally, you muſt reduce the vulgar Fraction to a Decimal.

Examp. Requir'd the Product of $4,\overset{,}{5}1\overset{,}{8}$ by $,41\dot{6}$.

$$\frac{4514}{999} \times \frac{375}{900} = \frac{4514 \times 375}{999 \times 900} = \frac{1662750}{999 \times 900}$$

Or thus decimally:

CASE 1ſt.

When only one of the Factors is a Circulate.

RULE.

Make the Circulate the Multiplicand, and having multiplied the Repetend by the firſt Figure of the Multiplier, divide the Product by as many 9's as there are Places in the Repetend, put down the Remainder (which is the Repetend of that Step) and carry the Quote to the Product of the finite Part; and ſo proceed with every Figure in the Multiplier, putting down the Products in common Form; then having made the Repetends ſimilar, the Total of the ſeveral Products is the Product ſought.

Example. What is the Product of $34{,}\dot{2}\dot{7}$ and $2{,}18$?

$$\begin{array}{rcl}
34{,}\dot{2}\dot{7} & & \\
2{,}18 & & \\
\hline
 & & \text{Similar.} \\
2741\dot{1}\dot{8} & = & 2741\dot{1}\dot{8} \\
34\dot{2}\dot{7} & = & 342\dot{7}\dot{2} \\
68\dot{5}\dot{4} & = & 6854\dot{5}\dot{4} \\
\cline{3-3}
\text{Product} & = & 74{,}71\dot{4}\dot{5}
\end{array}$$

CASE 2d.

When both Factors are Circulates.

RULE.

Take the finite Value of either Factor for the Multiplier, and by its Numerator multiply the other Factor (in the given Form) by Caſe 1ſt, and divide the Product by the Denominator of the Multiplier, the Quote is the Product ſought.

Examp. Requir'd the Product of $34,\dot{2}\dot{7}$ and $2,\dot{1}\dot{8}$.

$$2,\dot{1}\dot{8} = \tfrac{216}{99} \qquad \begin{array}{r} 34,\dot{2}\dot{7} \\ 2,16 \\ \hline \end{array}$$

$$\begin{array}{rcr} 205\dot{6}\dot{3} & = & 205\dot{6}\dot{3} \\ 34\dot{2}\dot{7} & = & 3427\dot{2}\dot{7}\!\!\!\!\!\!\! \\ 68\dot{5}\dot{4} & = & 6854\dot{5}\dot{4} \\ \hline \end{array}$$

$$99\ )\ 74,02\dot{9}\dot{0}\ (\ 74,77686595 = P.$$

$$\begin{array}{l} 472 \\ \;\;769 \\ \;\;\;\;760 \\ \;\;\;\;\;\;679 \\ \;\;\;\;\;\;\;\;850 \\ \;\;\;\;\;\;\;\;\;\;589 \\ \;\;\;\;\;\;\;\;\;\;\;\;940 \\ \;\;\;\;\;\;\;\;\;\;\;\;\;\;499 \\ \;\;\;\;\;\;\;\;\;\;\;\;\;\;\;\;40. \end{array}$$

D I V I S I O N.

RULE.

Reduce both Diviſor and Dividend to their finite Values, and then divide as in vulgar Fractions.

Examp. Divide $34,\dot{2}\dot{7}$ by $2,\dot{1}\dot{8}$, whoſe finite Values are $\tfrac{216}{99}$ and $\tfrac{3393}{99}$.

$$216\ )\ 3393\ (\ 15,708\dot{3}\ \text{Anſwer.}$$

$$\begin{array}{l} 1233 \\ \;\;1530 \\ \;\;\;\;1800 \\ \;\;\;\;\;\;720 \\ \;\;\;\;\;\;\;\;72. \end{array}$$

Or thus decimally:

CASE 1ſt.

When the Dividend is a Circulate, and the Diviſor is not.

RULE.

Divide as if both were finite Decimals, with this exception, *viz.* when the given Dividend is exhauſted, to the Remainders annex the Figures of the Repetend of the Dividend (inſtead of 0's, as in common.) See the Example to Caſe 2d of Multiplication, where 9 and 0 are annexed alternately.

CASE 2d.

When the Diviſor is a Circulate, and the Dividend is, or is not.

RULE.

Multiply the Dividend (in the given Form) by the Denominator of the finite Value of the Diviſor, the Product divided by the Numerator quotes the Quote ſought.

Examp. Divide $34{,}\dot{2}\dot{7}$ by $2{,}\dot{1}\dot{8}$, whoſe finite Value is $\frac{216}{99}$.

$$\begin{array}{r} 34{,}\dot{2}\dot{7} \\ 99 \\ \hline 308\dot{4}\dot{5} \\ 3084\dot{5}\dot{4} \\ \hline \end{array}$$

See Ex. 1ſt to Diviſion.

$216\ )\ 3393\ (\ 15{,}708\dot{3}$ Anſwer.

APPROXIMATING DECIMALS.

Note, *If all your given Decimals are Approximates, make them all conſiſt of a like Number of decimal Places, before you begin to add or ſubtract.*

ADDITION of APPROXIMATES.

RULE.

Make all too little or too much, marking the former with the Sign + (to ſhew that more ſhould be added) and the latter with the Sign — (to ſhew that ſomething ſhould be ſubtracted) and then the Sum (added as in common) will generally be an Unit or two of the laſt Places, too little if they are all too little, or too much if they are all too much; or rather make an equal Number of Defectives and Exceſſives.

Thus:

Examp. $\frac{13}{17} = 0,7647 +$

$3\frac{14}{17} = 3,8235 +$

$4\frac{13}{19} = 4,6842 +$

$\frac{16}{19} = 0,8421 +$

Sum = 10,1145 too little.

Or thus:	Or thus:
0,7648 —	0,7648 —
3,8236 —	3,8236 —
4,6843 —	4,6842 +
0,8422 —	0,8421 +
Sum = 10,1149 too much.	Sum = 10,1147

Hence the beſt way is to make as many defective as are exceſſive; for then, ſo far as they agree is certain, and no farther, as in Examp. 3d (in the two firſt only 10,114 are certain.)

SUB-

SUBTRACTION.

Make them both defective or both exceſſive, and then the Error will not exceed an Unit of the laſt Place.

Examp.	4,6842 +	4,6843 —
	3,8235 +	3,8236 —
	,8607	,8607

MULTIPLICATION.

CASE 1ſt. *When both Factors are Approximates.*

RULE.

Make one Factor more than juſt, and the other leſs; and then the uncertain Places are commonly one more than the Number of Places in the longeſt Factor.

Or,

Make a double Operation, the one with both Factors exceſſive, the other with both defective; then, ſo far as they agree, is certain, and no farther.

4,6842 +	4,6843 —
,8236 —	,8236 —
3,85780712 Product.	3,85698948 Product.

4,6842 +
,8235 +
3,85642870

In the firſt Example only 3,85 are certain by the Rule. But by the 2d and 3d Examples we find four Places certain, *viz.* 3,856, for ſo far they agree.

CASE 2d. *When one Factor is perfect, and the other is an Approximate.*

RULE.

The uncertain Places are commonly one more than the Number of Places in the complete Factor.

Or,

Make a double Operation, taking the Approximate defective in the one, and exceſſive in the other, ſo far as theſe Operations agree are certain, and no farther.

$$\begin{array}{r} 4{,}6843 + \\ 3{,}25 \\ \hline 14{,}223975 \end{array} \qquad \begin{array}{r} 4{,}6842 - \\ 3{,}25 \\ \hline 14{,}223650 \end{array}$$

By the firſt Rule only four Places are certain, but by the double Operation five Places are certain, *viz.* 14,223, for ſo far they agree.

DIVISION.

Take the Diviſor and Dividend, either both defective or both exceſſive, and divide as in common.

To determine the Number of certain Places in the Quote.

RULE.

There will (generally) be as many certain Places in the Quote, as there are Places leſs two in the firſt partial Dividend; which being determin'd before you begin to divide, you need carry the Quote no further.

Or,

Make a double Operation, taking in the one the Diviſor and Dividend both exceſſive, and in the other both defective, ſo far as theſe two Quotes agree is certain, and no farther.

,8235 +) 4,684210526 + (5,68817
56671
72610
67305
14252
60176
4531
,8236 —) 4,684250527 — (5,68745.

Now by the firſt Rule, ſince the firſt partial Dividend (4,6842) has five Places, from which ſubtracting two Places, there remains three, therefore there are but three Places (5,68) of the Quote certain, and therefore 'twas needleſs to purſue the Work further. By the ſecond Rule both Quotes agree ſo far as the three firſt Places, therefore ſo far and no farther is certain; which is the ſame as found by the firſt Rule.

DUODECIMAL ARITHMETIC.

ADDITION.

	Feet.	,	"	'''
	36	11	10	6
	04	9	6	4
	25	10	2	0
Sum =	67	7	6	10

SUBTRACTION.

From	36	4	9	2
Take	20	10	9	6
Remains	15	5	11	8

MULTIPLICATION.

General Rule. The Denomination of every particular Product is as many Places below the Denomination of either Factor, as the other Factor is below the Denomination of the Integer.

Examp. How many ſquare Feet are in the Floor of a Room 20 Feet, 10 Inches, and 9 Parts in Length, and 15 Feet, 6 Inches, 8 Parts in Breadth.

Thus:

F.	I.	P.		
20	10	9		
15	6	8		
313	5	3	„	= Product by 15.
10	5	4	6	= Product by 6.
1	1	11	2	= Product by 8.
325	0	6	8	= Product ſought.

Or thus:

	F.	I.	P.	
	20	10	9	
			5	
	104	5	9	
			× 3	
	313	5	3	„
Inches 6 = $\frac{1}{2}$ =	10	5	4	6
Parts 8 = $\frac{1}{9}$ =	1	1	11	2
	325	0	6	8 Product.

Examp. 2d. Multiply $2\frac{1}{2}$ Feet by $2\frac{1}{2}$ Feet.

	F.	I.	Or thus:			
	2	6	$2\frac{1}{2}$			
	2	6	$2\frac{1}{2}$			
	5	0	5			
	1	3	$1\frac{1}{4}$			
					F.	I.
Anſwer	6	3	Anſ. $6\frac{1}{4}$	Square Feet =	6	36.
						Requir'd

Requir'd the ſolid Content of a Wall that is $3\frac{1}{2}$ Feet thick, 10 Feet, 9 Inches, 6 Parts high, and 50 Feet, 7 Inches, 4 Parts long?

	F.	I.	P.	
	50	7	4	
×	10	9	6	
	506	1	4	
	37	11	6	
	2	1	3	8
	546	2	1	8
×	3	6		
	1638	6	5	0
	273	1	0	10
Anſwer	1911	7	5	10

Or thus:

259
×7

1813
×911
Solid Feet.

864) 1651643 ($1911\frac{539}{864}$ Anſwer.
7876
1004
1403
539.

Anſwer 1911 cubic Feet, 7 times 144 cubic Inches, 5 times 12 cubic Inches, and 10 cubic Inches, equal 1911 cubic Feet, and 1078 cubic Inches, or $\frac{539}{864}$ of a cubic Foot.

And thus, to find the ſuperficial Content of any Square, or Parallelogram, the Rule is, Multiply the Length by the Breadth, the Product is the Content ſought.

To find the ſolid Content of any Cube or Parallelopepid.

RULE.

Multiply the three Dimenſions together, the laſt Product is the ſolid Content ſought.

SEXAGESIMALS.

REQUIR'D the Sum of a ſidereal, tropical, and aſtronomical lunar Year, and the Difference of a ſidereal and tropical Year? Each as below expreſs'd.

ADDITION.

	D.	h.	m.	ſ.
Sidereal Year =	365	6	9	14
Tropical Year =	365	5	48	57
Lunar Year =	354	8	48	36
Sum	1084	20	46	47

SUBTRACTION.

	D.	h.	m.	ſ.
	365	6	09	14
—	365	5	48	57
Difference			20	17

MUL-

MULTIPLICATION.

Apply the general Rule already given.

	h.	′	″		
multiply	22	39	46		
by	5	6	30		
	113	18	50	00	Prod. by 5 h.
	2	15	58	36	Prod. by 6′.
	0	11	19	53	Prod. by 30″.
Product =	115	46	08	29	

A ſidereal Year is 365 Days, 5 Hours, 9 Minutes, 14 Seconds; the Preceſſion of the Equinoxes is 50 Seconds of the Ecliptic annually; the *Julian* Year is 365 Days, 6 Hours; but this being near 11 Minutes too much, Pope *Gregory* the XIIIth order'd 3 Days to be taken out of every 400 Years of the *Julian* Account, elapſed ſince the Year 325. 'Tis requir'd to determine the *Julian* and *Gregorian* Errors reſpectively, ſince the Birth of Chriſt, to the preſent Year (incluſively) 1758.

° D. h. m. ſ. ″ ′ ″
360—365 : 6 : 9 : 14—50(20 : 1 the 4th Ter. ſought.)
then { 365 : 6 : 9 : 14 = the ſidereal Year.
— 20 : 1 = the Diff. of a ſid. and trop. Y.

—365 : 5 : 49 : 13 = a tropical Year.
365 : 6 : — : — = a *Julian* Year.

: 10 : 47 = the Exceſs of a *Julian* above a tropical Year.

Y. ′ ″ Y. D. h. m. ſ.
1—10 : 47—1758 (13 : 3 : 57 : 6 the 4th Term.)
Y. D. Y. d. h. ′ ″
400—3—1433 (10 : 17 : 46 : 26 the 4th Term.)

D. h. ′ ″

13 : 3 : 57 : 6 = the *Julian* Error ſince Chriſt.

— 10 : 17 : 46 : 26 = the *Gregorian* Rectification.

2 : 10 : 10 : 30 = the *Gregorian* Error till the End of the Year 1758.

Hence the *Gregorian* Account hath err'd almoſt 2 Days and a half, on account of neglecting to rectify for the Time elaſped from the Birth of Chriſt to the congregating of the *Nicene* Council (325 Years); and conſequently if *Chriſtmas-day* be kept (even) according to the New Stile, it will happen on the 28th Day of *December* according to the true tropical Year; and there muſt be three Days added to any given Day of any Month, to give the true Day of that Month.

QUESTIONS to exerciſe Fractions.

		Multiply	By
Add	$\frac{3}{4}$, $\frac{5}{6}$ and $\frac{7}{8}$	$\frac{5}{6}$ of $\frac{7}{8}$	$\frac{4}{7}$
	$\frac{2}{9}$, $\frac{3}{7}$, $\frac{5}{8}$ and $\frac{4}{10}$	$\frac{3}{7}$ of $\frac{9}{10}$	$\frac{5}{6}$
	$\frac{4}{5}$, $\frac{6}{7}$, $\frac{3}{6}$ and $\frac{8}{11}$	$\frac{3}{9}$ of $\frac{7}{4}$ of $\frac{8}{10}$	$\frac{3}{7}$ of $\frac{4}{5}$
Add	$\frac{5}{6}$, $\frac{9}{3}$, $\frac{7}{8}$ and $\frac{3}{2}$	$\frac{4}{8}$ of $\frac{3}{9}$ of $\frac{1}{2}$	5
	$\frac{4}{3}$, $\frac{8}{6}$, $\frac{2}{5}$ and $2\frac{3}{4}$	$4\frac{5}{9}$ and $3\frac{4}{8}$	6
	$\frac{12}{4}$, $3\frac{1}{2}$, $\frac{4}{3}$ and $6\frac{4}{5}$	$9\frac{5}{8}$	$4\frac{2}{6}$
	Or	$3\frac{2}{5}$ and $\frac{9}{8}$	$6\frac{2}{9}$
	$\frac{12}{4}$, $\frac{7}{2}$, $\frac{4}{3}$ and $\frac{12}{5}$.	Or	
		$\frac{12}{5} + \frac{7}{6}$	$\frac{56}{9}$

	From	Take	Divide	By
Sub.	$\frac{4}{6}$	$\frac{1}{6}$	$\frac{3}{6}$	$\frac{3}{4}$
	$\frac{3}{7}$ and $\frac{2}{7}$	$\frac{4}{7}$	$\frac{5}{8}$	$\frac{4}{6}$
	$\frac{3}{4}$ and $\frac{7}{8}$	$\frac{4}{5}$ and $\frac{1}{8}$	$\frac{37}{49}$	6
	$3\frac{7}{8}$	$\frac{1}{4}$	$3\frac{3}{4}$	$\frac{5}{6}$
	$5\frac{3}{4}$	$\frac{6}{7}$	$\frac{3}{7}$ and $4\frac{4}{5}$	$\frac{7}{8}$
	$2\frac{1}{6}$ and $3\frac{4}{9}$	$1\frac{6}{8}$ and $2\frac{9}{10}$	$\frac{4}{9}$ and $\frac{3}{4}$	$7\frac{8}{9}$

The Uſe of theſe Rules.

1. Add 3 *s.* 4 *d.* and $1\frac{1}{2}$ *d.* and 5 *s.* 6 *d.* fractionally, 1 *l.* the Integer. Anſwer $\frac{43}{96}$ *l.*

2.

2. Add 5 *s.* 7 *d.* and 4 *s.* 6 *d.* and $\frac{3}{5}$ *d.* one Guinea the Integer. Anſwer $\frac{152}{315}$.

3. What Fraction of a Ton is 5 C. 3 q. 27 ℔. and 2 q. 13 oz. Anſwer $\frac{2393}{7168}$.

4. What Fraction of a Pound is the Difference of $\frac{3}{4}$ of a Guinea, and $\frac{2}{3}$ of a Moidore? Anſwer $\frac{9}{80}$ *l.*

5. What Fraction of a Moidore is the Difference of $\frac{4}{5}$ of 9 *s.* 6 *d.* and $\frac{1}{6}$ of $\frac{1}{2}$ a Guinea, increas'd by $\frac{6}{7}$ of a Pound, and leſſen'd by $\frac{9}{10}$ *s.* Anſwer $\frac{821}{1260}$ *l.*

6. How many Pence are in $\frac{3}{4}$ of $\frac{5}{6}$ of a Pound? Anſwer 150 *d.*

7. What Fraction of a 36 Shilling-piece is 5 times $\frac{3}{7}$ of $\frac{9}{10}$ of a Crown, and $\frac{1}{2}$ of a Guinea? Anſwer $\frac{93}{112}$.

8. What Part of 15 *s.* is 3 Pence? Anſwer $\frac{1}{60}$.

9. What is the Quote of 15 *s.* divided by 3 *d*? Anſwer 60.

10. *Peter*, who had $\frac{1}{2}$ of a Ship, ſold $\frac{1}{3}$ of his Share to *Paul*, and *Paul* ſold $\frac{3}{4}$ of his Share to *Paywell*, and then *Paul* bought $\frac{2}{5}$ of *Peter*'s Intereſt in the Ship: The Ship is freighted to a certain Port for 40 *l.* how muſt this be divided among the Owners? Anſwer, *Peter* 8 *l.* *Paul* 7 *l.* and *Paywell* 5 *l.*

EXTRACTION OF THE SQUARE ROOT.

RULE.

1ſt. POINT the given Number, by putting a Daſh over the Unit's Place, then over the third, fifth, &c. Figures, ſo that every Period may contain two Places. — Then ſeek the greateſt Square in the firſt (left-hand) Period, whoſe Root put in the Quote, and from the firſt Period ſubtract the Square; to the Remainder annex the next Period for a Reſolvend.—Then divide the Reſolvend (excluſive of the Unit's Place) by double the Quote, put the

Quote-figure in the Quotient, and alſo annex it to the Diviſor, then from the Reſolvend ſubtract the Product of the complete Diviſor and Quote-figure.—Then to the Remainder annex the next Period for a Reſolvend; and ſo proceed till you have us'd all the Periods in the given Number.

Ex. What's the Square Root of 119550669121?

$$
\begin{array}{rl}
 & \overset{,}{1}1\overset{,}{9}5\overset{,}{5}0\overset{,}{6}6\overset{,}{9}1\overset{,}{2}1\ (\ 345761 = \text{the Root.} \\
 & -9 \\
60+4=64\ ) & 295 \\
 & -256 \\
680+5=685\ ) & 3950 \\
 & -3425 \\
6900+7=6907\ ) & 52566 \\
 & -48349 \\
69140+6=69146\ ) & 421791 \\
 & -414876 \\
691520+1=691521\ ) & 691521 \\
 & -691521 \\
\hline
 & 0
\end{array}
$$

EXTRACTION OF THE CUBE ROOT.

RULE.

1ſt. POINT the given Number, beginning at the Unit's Place, and leaving two Places between every two Points.

2d. From the firſt Period ſubtract the greateſt Cube contain'd therein, put the Root in the Quote, and to the Remainder annex the next Period for a Reſolvend.

3d. Divide the Reſolvend by 300 times the Square of the Quote, but with this Limitation, *viz.* that 30 times the Square of the preſent Quote-figure multiply'd by the former Quote, and the Cube of the preſent Quote-figure, being (both) added to the Product of the Diviſor and Quote figure, the Sum of theſe three (which muſt be ſubtracted from the Reſolvend, and therefore) may not exceed the Reſolvend, and ſo proceed (*viz.* as in the 3d Step) through all the Periods.

Ex. What's the Cube Root of 8787727019456?

$$8,787,727,019,456 \;(\; 20636 \text{ the Root.}$$

$$2^3 = 8$$

$$\overline{20}\rceil^2 \times 300 = 120000\;).\;787727 \text{ Reſolvend.}$$

$$-720000 = 120000 \times 6$$

$$-21600 = \overline{20 \times 6^2} \times 30$$

$$-216 = 6 \times 6 \times 6$$

$$\overline{206}\rceil^2 \times 300 = 12730800\;)\overline{45911019} \text{ Reſolvend.}$$

$$-38192400 = 12730800 \times 3$$

$$-55620 = \overline{206 \times 3^2} \times 30$$

$$-27 = 3 \times 3 \times 3$$

$$\overline{2063}\rceil^2 \times 300 = 1276790700\;)\overline{7662972456} \text{ Reſolvend.}$$

$$-7660744200 = 1276790700 \times 6$$

$$-2228040 = \overline{2063 \times 6^2} \times 30$$

$$-216 = 6^3$$

$$\overline{}$$

$$0$$

RECREATION I.

1. IF in the Courſe of Exchange between *England* and *Ireland*, *England* gains 8⅓ *per Cent.* what does *Ireland* loſe *per Cent?* Anſwer 7 9/13.

2. What is a Gilder worth in *Ireland*, if the Exchange between *England* and *Ireland* is 8⅓ *per Cent.* Advance for *Ireland*, and between *England* and *Holland* 34⅓ *s. Flemiſh per* Pound Sterling? Anſ. 2 32/309 *s.*

3. If a *French* Crown paſſes for 4 *s.* 10 *d.* in *Ireland*, and *Rotterdam* exchanges with *London* at 34 *s.* 6 *d. Flemiſh per* Pound Sterling, and *London* with *Ireland* at 9 *per Cent.* Advance for *Ireland*; how many *French* Crowns muſt be paid in *Paris* for a Bill of 436 Gilders and 10 Stivers? Anſ. 190 146/667 Crowns.

4. Which is moſt advantageous for a Merchant in *Ireland*, to have Milrees remitted to him from *Portugal*, which paſs for 7 *s.* in *Ireland*, or to have Moidores of 4000 Res each, remitted to *London* at 27 *s. per* Moidore, allowing a Diſcompt of 2½ *per Cent.* and from thence to *Ireland* at 8 *per Cent.* Advance? Anſwer, 'tis more advantageous to have the Remittance made to *London*, and from thence to *Ireland*, by 92/205 *per Cent.*

5. A Merchant in *London* ſends to *France* 296 C. of Butter, which ſtands him in 25 *s. per* C. and when landed in *France*, the Charges (including Freight, Porterage, &c.) amounts to 2½ *per Cent.* alſo the Factor's Commiſſion is 2½ *per Cent.* upon the Sale; for how many Livres (of 5 to the Crown) muſt this Butter be ſold in *France*, to clear 20 *per Cent.* for the Merchant, if the Money can be remitted to *Dublin* at 4 *s.* 10½ *d. per* Crown, and from thence to *London* at 8⅓ *per Cent.* Advantage for *London?* Anſw. 10372 76/117 Livres.

6. If the Scavenger's Rate at 1½ *d. per l.* for ⅘ of the Rent comes to 3 *s.* 9⅗ *d.* what will the Landlord receive annually for ſaid Houſe, when the King's Tax

is 3 *s.* 6 *d.* *per* Pound for 17 *l.* in 19 of the Rent? Anſw. 32 *l.* 1 *s.*

7. If the Poors Rate be to the King's as 4 to 5 for $\frac{4}{5}$ of the Rent, and in collecting it the Overſeers ſpend $\frac{2}{7}$ in a Shilling; how much will the Poor be defrauded (by their charitable Agents) where the King's Tax at 2 *s.* 6 *d.* *per* Pound for $\frac{3}{4}$ of the Rent, amounts to 625 *l.* 5 *s?* Anſw. 160 *l.*

RECREATION II.

1. *A*, *B*, *C* being in Company, *A*'s Stock and Gain makes 36 *l.* *B*'s 54, and *C*'s 84; they gain 29 *l.* (the Times being equal) I demand each Man's Stock and Gain ſeverally? Anſw. *A*'s Stock 30 *l.* his Gain 6 *l.* *B*'s 45, his Gain 9 *l.* *C*'s 70, his Gain 14 *l.*

2. *A*, *B*, *C* in Company gain 87 *l.* *A*'s Gain is to *B*'s as 2 to 3, and the Difference of their Stocks is 15 *l.* requir'd each Man's Stock and Gain? Anſw. *A*'s Stock is 30 *l.* and Gain 18 *l.* *B*'s 45 and 27, *C*'s 70 and 42.

3. *A*, *B*, *C* put in equally; *A* gains 6 *l.* *B* 9, *C* 14, and the Total of the Times is 145 Days, how long did each Man's Stock continue in Company? Anſw. *A*'s 30 Days, *B*'s 45, and *C*'s 70.

4. Three Merchants put in equally, the Sum of *A*'s Gain and Time in Pounds and Months is 42, *B*'s 54, and the Total of the Times is 28 Months; requir'd each Man's Time and Gain ſeverally? Anſ. *A*'s 7 Months and 35 *l.* *B*'s 9 Months and 45 *l.* *C*'s 12 and 60.

5. Suppoſe in the laſt Caſe the Difference of *A*'s and *B*'s Time (inſtead of the Total) equal 2 Months, given to find the Times and Gains? Anſw. as above.

6. Three Merchants, by a Joint-ſtock, gain equally; the Stocks of *A*, *B*, *C* are in proportion as 2, 3, 5, and the Difference of *B*'s and *C*'s Time is $6\frac{2}{3}$ Months, how long did each Man's Stock continue in Trade? Anſw. *A*'s 2 Years and 1 Month, *B*'s $16\frac{2}{3}$ Months, and *C*'s 10 Months.

7. *A*, *B*, *C* put in ſeverally 15 Pieces of Cloth, and gain equally; but thoſe of *A* coſt 25 *l.* more than thoſe of *B*; alſo *A*'s Cloth continued in Company 6 Months, *B*'s $9\frac{1}{3}$ Months, and *C*'s 14 Months; requir'd the prime Coſt of each Man's Cloth *per* Piece? Anſw. *A*'s 4, 13, 4, *B*'s 3 *l.* and *C*'s 2 *l.*

8. Three Merchants gain equally; *A* puts in a certain Sum for 6 Months, *B*'s Time is $9\frac{1}{3}$ Months, and *C*'s 14 Months, the Sum of the Products of the correſponding Stocks and Times is 1260; requir'd each Man's Stock? Anſw. *A* 70 *l.* *B* 45 *l.* *C* 30 *l.*

9. *A* puts in a certain Sum for 30 Months and 10 Days, *B*'s Money continues in Trade 20 Months and 15 Days, and *C*'s 16 Months and 10 Days; they gain 67 *l.* 10 *s.* of which *A* and *C* take 47 *l.* but *C* takes 30 *s.* more than *A*; what is each Man's Stock, allowing 30 Days to a Month? Anſw. *A*'s 30 *l.* 6 *s.* 8 *d.* *B* 20 *l.* 5 *s.* *C* 16 *l.* 3 *s.* 4 *d.*

10. *A* puts in 360 *l.* and gains 63 *l.* 9 *s.* *B* by 480 *l.* gains 56 *l.* 8 *s.* and *C* by 720 *l.* gains 42 *l.* 6 *s.* Now if the Total of the Products (taken in Pounds and Months) be 16560, how long hath each Man's Stock continu'd in Company? Anſw. *A*'s $1\frac{1}{2}$ Year, *B*'s 1 Year, and *C*'s $\frac{1}{2}$ a Year.

11. Six Merchants being in Company; *A* puts in 160 *l.* for 9 Months, and takes 172 *l.* for Stock and Profit; *B* puts in a certain Sum for 6 Months, and takes 210 *l.* *C* puts in 240 *l.* for a certain Time, and takes 264 *l.* *D*'s Money continues in Trade 4 Months, and gains equally with *C*; *E* puts in 350 *l.* and gains 35 *l.* *F* puts in 480 *l.* and gains 14 *l.* 8 *s.* alſo the Aggregate of the Times is 3 Years and 8 Months.

I demand *B*'s and *D*'s Stock, and *C*'s, *E*'s and *F*'s Times, the two latter Gentlemen being allowed a greater Profit than the reſt, for acting as Factors? Anſw. *B* and *D*'s Stocks are 200*l.* and 720*l.* *C*, *E*, and *F*'s Times are 12, 10, and 3 Months.

FACTORAGE.

12. A Merchant puts in 360*l.* allowing his Factor to put in 60*l.* and values his Service at 30*l.* they gain 210*l.* what is the Factor's Share of the Gain? Anſw. 42*l.* or 45*l.*

13. A Merchant puts in 360*l.* his Factor 60*l.* and receives 42*l.* of the Gain, the Merchant 168*l.* what was the Factor's Service valu'd at? Anſw. 30*l.* or 24*l.*

14. A Merchant puts in 360*l.* the Factor's Service is valu'd at 30*l.* what Sum did he put in if he takes 42*l.* of the Gain, equal 210*l*? Anſw. 60*l.* or 52*l.* 10*s.*

15. A Merchant puts in 360*l.* now if the Factor is allow'd $\frac{1}{7}$ of the Gain for his Service, what real Stock muſt he put in to have $\frac{1}{3}$ of the Gain? Anſw. 90*l.* or 75*l.*

RECREATION III.

1. HAVING caught a Fiſh, whoſe Body is 42 Feet in Length, I find the Head to be $\frac{2}{7}$ of the whole Length leſs $\frac{1}{7}$ of this, and the Tail is $\frac{2}{7}$ of the whole Length more $\frac{1}{7}$ of this; I demand the entire Length of the Fiſh? Anſw. 98 Feet.

2. *Samuel* finds his Sweetheart *Suſan*'s Fortune is $\frac{1}{3}$ of her Father's Eſtate; the Triple of *Samuel*'s Fortune is equal to the Double of *Suſan*'s; now if

the Total of all their Fortunes be 700 *l.* I demand that of each? Anſw. *Sam.* 100 *l.* *Suſan* 150 *l.* the Father 450 *l.*

3. Bought a Piece of Cloth for 15 *l.* and find to have gain'd 10 *per Cent.* by ſelling the Piece wanting 4 Yards for 13 *l.* 4 *s.* requir'd the Length of the Piece, and prime Coſt *per* Yard? Anſw. 20 Yards at 15 *s.* each.

4. Bought a Piece of Cloth at 12 *s.* *per* Yard, and by ſelling the ſame for 10 *l.* 5 *s.* $8\frac{4}{7}$ *d.* I find to have loſt $\frac{2}{7}$ in a Shilling; requir'd the Length of the Piece? Anſw. 24 Yards.

5. Bought a Drove of Sheep for a certain Sum, which if I ſell at 25 *s.* each, I ſhall gain 20 *l.* by the whole, but if I ſell them at 20 *s.* a piece, I ſhall looſe 5 *l.* I demand the Number bought, and prime Coſt? Anſw. 100 at 21 *s.* each.

6. A Lady being aſk'd her Age, reply'd, if you multiply $\frac{3}{4}$ of double my Age by $\frac{5}{6}$; and divide $\frac{1}{2}$ of my Age by $\frac{2}{5}$, the Sum of the Reſults will be 80 Years; what was her Age? Anſw. 32 Years.

7. *Tom* ſets out from *London* to *Briſtol*; at the ſame time *Dick* ſets out from *Briſtol* to *London*, on the 6th Day they meet; now allowing theſe Towns to be 120 Miles aſunder, I demand how many Miles *per* Day each travels, if *Tom* travels 3 Miles *per* Day more than *Dick?* Anſw. *Tom* $11\frac{1}{2}$, and *Dick* $8\frac{1}{2}$ Miles *per* Day.

8. A Company of Men, Women and Children, (of each an equal Number) have ſpent 16 *s.* 8 *d.* each Man paid 6 Pence, a Woman 4 Pence, and a Child $2\frac{1}{2}$ Pence; how many Perſons were there of each ſort? Anſw. 16.

9. A young Gentleman being aſk'd his Age, anſwer'd, that double the Cube of $\frac{1}{2}$ his Age made 3456 Years; what was his Age? Anſw. 24 Years.

10. *A*, *B*, *C* being in Company, they find that *C*'s Gain is 50 *l.* when *A* takes $\frac{1}{4}$, *B* takes $\frac{1}{3}$, and *C* $\frac{1}{2}$; now if *A*'s Stock and Gain is 366 *l.* 13 *s.* 4 *d.*

what is the total Stock, and Gain *per Cent?* Anſw. total Stock 1083 *l.* 6 *s.* 8 *d.* and 10 *per Cent*. Gain.

11. 'Tis requir'd to multiply 19 *l.* 19 *s.* 11$\frac{3}{4}$ *d.* by the ſame, in one Line? Anſw. 399 *l.* 19 *s.* 2$\frac{1}{3840}$ *d.*

12. If for 672 Guineas and triple Crowns (of each an equal Number) I buy 840 Yards of Cloth; how many Yards can I buy for 3 *l.* 12 *s?* Anſw. 5 Yards.

13. If 672 Guineas and triple Crowns (of each an equal Number) are paid for 840 Yards; what will 10 Yards coſt? Anſw. 7 *l.* 4 *s.*

Note, *Either of theſe two Queſtions may be wrought by three Figures only.*

14. There were employ'd at the Eaſt-end of *Solomon*'s Temple, a certain Number of Maſons, whoſe Joint-bill made 292 *l.* 10 *s.* each Maſter-maſon charg'd 5 *s.* *per* Day, a Journeyman 4 *s.* and an Apprentice half a Crown; there were double as many Apprentices as Journeymen, and $\frac{1}{3}$ as many Maſters as Journeymen; alſo for every 8 Days an Apprentice wrought, a Journeyman wrought 5, and a Maſter 3; how many Journeymen, Apprentices, &c. were there ſeverally, and how many Days have they wrought reſpectively? Anſw. 10 Maſters, who wrought 9 Days; 30 Journeymen, who wrought 15 Days; and 60 Apprentices, who wrought 24 Days.

Note, *This Queſtion admits ſeveral Anſwers.*

15. *Light Foot* and *Heavy Heels* ſet off from one Place, and travel one way round *London* (which ſuppoſe 21 Miles in Circuit) *Light Foot* travels 6 Miles *per* Hour; and *Heavy Heels* 4$\frac{1}{2}$ Miles *per* Hour till he hath got on the oppoſite Point of the Ambit with *Light Foot*, after which he travels 4 Miles *per* Hour; the Queſtion is, in how many Hours they will come together again, and how many Times *Light Foot* will then have circumſcrib'd the City? Anſw. in 12$\frac{1}{4}$ Hours, and 3 Times.

16. At the South-ſide of *Solomon*'s Temple were employ'd 70 Maſter-maſons, who had each 100 Ap-

prentices, who earn'd in 6 Weeks 47250 Pounds and Crowns, quadruple as many of the latter as of the former; alſo at the North-ſide were 30 Maſters, who had each 150 Journeymen, whoſe daily Wages were ſeverally double to the Apprentices; how many Crowns of 5 *s.* and Millrees of 6 *s.* 6 *d.* (3 of the former for 5 of the latter) did the Journeymen earn in 9 Weeks of 5 Days each? Anſwer, 38368$\frac{9}{15}$ Crowns, and 63947$\frac{7}{15}$ Millrees.

17. A Privateer being mann'd with 260 Men for a 6 Month's Cruiſe, have laid in ſuch a Quantity of Proviſions that each Man may have 1 ℔. of Beef and 1$\frac{1}{2}$ ℔. of Bread *per* Day; the Cruiſe being half out, they meet a Ship of War, and in the Fight loſe $\frac{1}{5}$ of their Men; alſo by Accident they have loſt 50 Loaves of 3 ℔. each; what is each Man's Allowance *per* Day for the Remainder of the Voyage, if they prolong it one Month, allowing 30 Days to a Month? Anſw. 15 oz. of Beef, and 1 ℔. 2$\frac{667}{832}$ oz. of Bread.

18. Three Perſons hire a Coach for 10 *l.* from *London* to *Briſtol* (ſuppoſe 112 Miles) with Condition, that if they take in Company by the Way, the Profit ſhall be allowed to them; when they have travel'd half way, they take in a Gentleman and his Wife, agreeing that each Company ſhould pay in proportion to their Number and Diſtance travell'd; how much ſhould each Company pay? Anſwer, the firſt Company 7 *l.* 10 *s.* the ſecond 2 *l.* 10 *s.*

RECREATION IV.

1. MISS *Biddy* being aſk'd her Age, to ſhew her Learning reply'd thus, *viz.* if from $\frac{4}{5}$ of my Age you ſubtract 3, double the Remainder leſs 4, will exceed my Age by a ſixth Part of the Reſult; pray, what was her Age? Anſw. 25 Years.

2. I have mix'd 30 Gallons of Water with 60 Gallons of Brandy, of which Compound the ſixth Part being loſt, I find to have gain'd $4\frac{1}{2}$ *per Cent.* by ſelling the Remainder at the Rate of 10 *s.* *per* Gallon for the pure Brandy; how was the Water rated in this Caſe? Anſw. 4 *s.* *per* Gallon.

3. *Simon Smart* being aſk'd by *Laurence Logerhead* what o'Clock it was, anſwer'd, that $\frac{3}{4}$ of the Time paſt Noon was equal to $\frac{4}{3}$ of the Time till Midnight; pray, what o'Clock was it? Anſw. 40 Minutes, 48 Seconds paſt 7 in the Afternoon.

4. An arithmetical Lady (looking at her Watch in the Afternoon, between 7 and 8 o'Clock) was aſk'd the Hour of the Day; to which ſhe anſwer'd, that the Hour and Minute-hand were together; requir'd the exact Time? Anſw. 38 Minutes, $10\frac{10}{11}$ Seconds after 7.

5. A Ciſtern has 4 Cocks, *A*, *B*, *C*, *D*; by the Cock *A* it can be fill'd in 5 Hours, by *B* in 3 Hours, by *C* in 4 Hours, and by *D* in $\frac{3}{4}$ of an Hour; alſo at the Bottom are 3 Holes, *E*, *F*, *G*; by *E* the Ciſtern can be empty'd in 3 Hours, by *F* in $3\frac{1}{2}$ Hours, by *G* in $\frac{3}{4}$ of an Hour; now if the filling Cocks are all ſupply'd at once, and the bottom Holes all open, in what Time will the Ciſtern be filled? Anſw. in $2\frac{2}{109}$ Hours.

6. Sold Velvet at 18 *s.* *per* Yard, and thereby loſe $\frac{1}{10}$ of the prime Coſt; ſold another Parcel of the ſame for 50 *l.* and thereby clear 50 *per Cent.* requir'd

the Quantity and prime Coſt of the laſt Parcel? Anſw. $33\frac{1}{3}$ Yards, at 30 *s.* *per* Yard.

7. A Wall of 300 Feet long, 10 Feet high, $3\frac{1}{2}$ Feet thick, is to be built with Stones of $\frac{3}{4}$ Foot long, $\frac{3}{8}$ Foot broad, and 3 Inches thick (including the Mortar); how many ſuch Stones are requiſite? Anſwer $138222\frac{2}{9}$ Stones.

8. Suppoſe in the foreſaid Wall the Number of Stones, and all the Dimenſions, except the Length, were given, to find the Length?

9. Or the Breadth or Height may be ſought, the reſt being given?

10. Sold 3 ſilver Watches for 7 *l.* 10 *s.* and thereby loſe $16\frac{2}{3}$ *per Cent.* what is the Gain or Loſs *per Cent.* when I ſell one of thoſe Watches for 4 *l*? Anſw. $33\frac{1}{3}$ *per Cent.* Gain.

11. Two Ships laden with one ſort of Wine, in *A* 170 Hhds, in *B* 425 Hhds; coming by a certain Port, *A* pays for Duty 1 Hhd, and receives 5 *s.* back, *B* pays 2 Hhds, and 5 *l.* 17 *s.* 6 *d.* more; what was the Wine valu'd at *per* Hhd? Anſw. 13 *l.*

12. Two Ships, *A* and *B*, in *A* 360 Hhds of Wine, in *B* 480 Hhds; but 4 Hhds of *B*'s Wine are equal in Value to 5 of *A*'s; however they being both tax'd at the ſame Rate *per* Hhd, *A* pays for Toll 3 Hhds, and receives 15 *l.* back, *B* pays 2 Hhds, and 10 *l.* more; what are both Cargoes worth when ſold for $\frac{4}{5}$ Profit, after the Duty is paid? Anſwer, 23166 *l.*

13. How many Yards of Paper $1\frac{3}{8}$ Yards broad, will hang a Room of 20 Feet long, $15\frac{1}{2}$ Feet wide, and $12\frac{1}{4}$ Feet high? Anſw. $70\frac{28}{99}$ Yards.

14. If 6 ſilver Watches, and 6 Guineas, are equal in Value to 9 Watches leſs 3 Guineas; what is the Value of a Watch? Anſw. 3 *l.* 3 *s.*

15. A Silverſmith having ſhew'd me a Parcel of Watches in a Caſe, we agreed that I ſhould pay as many Crowns for one Watch, as there were Watches

in the Caſe; but the Proprietor (having miſtaken the Number) ſaid I had fairly outwitted him, for he loſt $\frac{1}{7}$ in a Shilling by me, whereas he ſhould have gain'd 10 *per Cent*. how much then was the Watch ſold under the juſt Value, if 100 *l.* would pay for all in the Caſe according to our Agreement? Anſwer 1 *l.* 8 *s.* 4 *d.*

RECREATION V.

1. FOUR Painters (*Daub*, *Colour*, *Poliſh*, and *Bruſh*) have painted a certain Number of Cups; *Daub* has painted the Cube of 3, which is equal to the Number painted by *Poliſh* and *Bruſh*; alſo *Daub* and *Bruſh* have painted double as many as *Colour* and *Poliſh*; and *Poliſh* has painted $\frac{1}{2}$ as many as *Colour* and *Bruſh*; how many have each painted? Anſwer, *Colour* 9, *Poliſh* 12, and *Bruſh* 15.

2. *Carmine*, *Puff*, and *Clearſtarch* have together earn'd 2 *l.* 12 *s.* 6 *d.* by painting of China-diſhes, at the Rate of half a Crown a Day *per* Man; *Carmine*'s and *Puff*'s Diſhes together make 80, *Clearſtarch's* and *Puff*'s make 110, *Carmine*'s and *Clearſtarch*'s make 90; alſo *Clearſtarch*'s Wages *per* Diſh is only $\frac{1}{2}$ of *Carmine*'s, and the Triple of *Puff*'s is equal to the Quadruple of *Clearſtarch*'s; how many Days have they wrought ſeverally? Anſw. *Carmine* 5, *Puff* 8, and *Clearſtarch* 7 Days.

3. A Captain of a Man of War paying off his Men, finds that if he had 6 Men leſs, he ſhould then have 63 *l.* more than neceſſary; but if he had 8 Men more he ſhould want 84 *l.* how many Men had he? Anſwer 500 Men.

4. Suppoſing that a Hound makes 5 Leaps, while a Hare makes 6, and that 4 of the Hound's Leaps are equal to 5 of the Hare's; how many Leaps will each have made when the Hound hath taken her, allowing the Hare to be 300 of her own Leaps before the Hound at ſtarting? Anſw. the Hound 6000, and the Hare 7200 Leaps.

5. *Sally Rover* having twice as many Girls as Boys, propoſes her eldeſt Daughter *Smiling Dolly* (juſt 20) to *Robert Readymoney*'s Son and Heir *Shining Roger*; but *Dolly*, determin'd to try *Roger*'s Genius, tells him, that there were two Years between every two adjacent Births of her Mother's Children, and that the Sum of all their Ages was equal to 12 Times the Number of Children; how many Brothers and Siſters had *Dolly?* Anſw. 3 Brothers and 5 Siſters.

6. An honeſt Wine-merchant has a Veſſel containing 400 Gallons of Wine, out of which he draws 40 Gallons, and then fills it up with Water, and doth ſo 4 Times; how much Wine and Water (ſeverally) remains in the Veſſel? Anſw. $262\frac{11}{25}$ Gallons of Wine, and $137\frac{14}{25}$ Gallons of Water.

7. At a certain Tavern there happen'd to meet ſuch a Number of Maſons, as that the continual Product of $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{5}{7}$ of their Number made 17640, and there were $\frac{1}{2}$ as many Maſters as Journeymen, and quadruple as many Journeymen as Apprentices; requir'd the reſpective Numbers? Anſw. 12 Maſters, 24 Journeymen, and 6 Apprentices.

8. Bought 20 five-gallon Caſks of Liquor for 15*l.* now if the Price of *Meridan* Ale be to that of Gin, as 4 to 3; of Wine to Brandy, as 5 to 4; of Ale to Wine, as 1 to $1\frac{2}{3}$; I demand the Species of the Liquor bought, eſtimating the Wine at 6*s.* 8*d.* *per* Gallon? Anſw. Gin.

9. Laid out 100*l.* for 23 Watches, *viz.* Silver and *Pinchbeck*, the *Pinchbeck* at 4*l.* and the Silver

at 4 *l.* 10 *s.* the Queſtion is, how many I bought of each Sort? Anſw. 16 Silver, and 7 *Pinchbeck*.

10. If 16 ℔. of *A* are equal to 9 ℔. of *B*, and 27 of *B* equal 32 of *C*, and 15 of *C* equal $7\frac{1}{2}$ of *D*; how many ℔. of *A* are equal to 12 of *D*? Anſw. 36 ℔. of *A*.

Note, *This Queſtion may be wrought by three Figures, excluſive of the Stating and Anſwer.*

11. In barter *A* raiſeth 30 *s.* worth of Goods to 40 *s.* and gives 6 Months Time for the Payment; *B*'s Goods are worth 20 *s.* and he agreeing to give 10 Months Time, is deſirous to know how he ſhould raiſe his Goods? Anſw. to 31 *s.* $1\frac{1}{3}$ *d.*

12. If *B* parts with his Goods at 31 *s.* $1\frac{1}{3}$ *d.* and gives 10 Months; and *A* raiſeth his Goods from 30 to 40 *s.* and gives 6 Months Credit; requir'd the prime Coſt of *B*'s Goods? Anſw. 20 *s.*

13. *B* raiſeth 20 *s.* to 31 *s.* $1\frac{1}{3}$ *d.* *A* raiſeth 30 *s.* to 40 *s.* and gives 6 Months; what Time ſhould *B* give? Anſw. 10 Months.

14. *A* barters 20 Pieces of Velvet, each containing 20 Yards at 30 *s.* *per* Yard, which is worth but 25 *s.* ready Money; and if *B* will pay him $\frac{1}{5}$ of the Barter-value in ready Money, he is willing to allow a Diſcompt thereon of 10 *per Cent.* how many Yards of coarſe Cloth at $10\frac{18}{35}$ *s.* *per* Yard, and fine Cloth at $19\frac{5}{7}$ *s.* *per* Yard (3 of the former for 2 of the latter) muſt *B* deliver with the foreſaid Sum, to make the Barter equal; and what is *B*'s Cloth worth *per* Yard ready Money? Anſw. *B* delivers $353\frac{21}{99}$ Yards of coarſe Cloth, and $236\frac{8}{297}$ Yards of fine, the former worth 8 *s.* *per* Yard ready Money, and the latter 15 *s.*

15. *A* barters 15 C. $7\frac{8610}{10443}$ ℔. of Hops at three Guineas *per* C. which are worth but 59 *s.* ready Money; how much ready Money muſt *B* pay with a Hogſhead and a half of Wine worth 6 *s.* *per* Gal-

lon ready Money to make an equal Barter? Anſw. 16 *l.* 2 *s.* $1\frac{109}{236}$ *d.*

16. *A* has 100 Reams of Paper at 8 *s.* ready Money, which he ſets down in barter at 10 *s.* *B* ſenſible of this, has Pamphlets at 6 *d.* a-piece ready Money, which he adequately charges and inſiſts, beſides on $\frac{1}{4}$ of the (barter) Price of thoſe he parts with in Specie; what Number of the Books is he to deliver in lieu of *A*'s Paper; what Caſh will make good the Difference, and how much is *B* the Gainer by this Affair? Anſw. *A* muſt pay 16 *l.* 13 *s.* 4 *d.* in Money, *B* muſt deliver $2133\frac{1}{3}$ Pamphlets, and he gains 3 *l.* 6 *s.* 8 *d.*

RECREATION VI.

1. A Gentleman after ſpending $\frac{2}{5}$ of $\frac{1}{8}$ of his Eſtate, lays out 3050 *l.* in Houſes, and puts $\frac{2}{11}$ of the Remainder at Intereſt at $5\frac{1}{5}$ *per Cent. per Annum*, for 5 Years; and with $\frac{1}{4}$ of the Amount freights a Ship, which Adventure his Factor ſells for $\frac{1}{9}$ Profit, and after deducting 10 *per Cent.* for all Charges, remits the Gentleman 300 *l.* for the neat Proceeds; what was the Value of the Gentleman's Eſtate at the Beginning? Anſw. 9000 *l.*

2. Bought Spices to the Amount of 26 *l.* 8 *s.* at 5 *s.* 6 *d.* *per* ℔. part of which being damag'd, the Remainder at 6 *s.* *per* ℔. amounts to 15 *l.* how muſt I ſell the damag'd Part to loſe 5 *per Cent.* by the whole? Anſw. 4 *s.* $4\frac{54}{115}$ *d.*

3. Laid out 88 *l.* 4 *s.* in Wine, but a Veſſel containing $\frac{2}{9}$ of the whole, being ſo adulterated with Water that I can make but 6 *s.* *per* Gallon of it, (rating the Wine at prime Coſt) and thereby loſe 2 *l.* 16 *s.* I deſire to know at what Rate *per* Hog-

ſhead I muſt ſell the Remainder to clear 5 *per Cent.* by the whole, and what Quantity of Water was in the adulterated Veſſel? Anſw. the Remainder muſt be ſold at 24 *l.* 7 *s.* $4\frac{1}{5}$ *per* Hogſhead, and there were 8 Gallons of Water put in.

4. A Gentleman increas'd his Eſtate annually a fourth Part abating 80 *l.* and at the End of $4\frac{1}{2}$ Years was worth 9548 *l.* 10 *s.* $1\frac{1}{2}$ *d.* what was he worth at the Beginning? Anſw. 3680 *l.*

5. A Gentleman increas'd his Eſtate wanting 80 *l.* a fourth Part annually, and at the End of $4\frac{1}{2}$ Years found himſelf worth 9301 *l.* 5 *s.* $9\frac{3}{8}$ *d.* what was he worth at firſt? Anſw. as above.

6. A Merchant began Trade with a certain Sum, and gain'd a fourth Part of the ſame annually wanting 80 *l.* at the End of $4\frac{1}{2}$ Years, the Net of his Eſtate was 7460 *l.* pray, what was his firſt Stock? Anſw. as above.

7. A Merchant began Trade with a certain Sum, and gain'd annually a fourth Part of the ſame wanting 80 *l.* and at the End of $4\frac{1}{2}$ Years was worth 7730 *l.* what Stock did he begin with? Anſwer, as above.

8. A certain Number of valiant *Swedes*, being ſuddenly inſpir'd with a fighting Spirit, they for 277 *l.* 4 *s.* fit out a ſtout Privateer; and admit as Partners 20 *Britons*, 16 *Hybernians*, and 30 *Pruſſians*: In a certain Latitude they eſpy a ſurly Ship of War making full Sail towards them; upon this Occaſion the *Swedes* (among themſelves) hold a Council of Peace (vulgarly call'd a Council of War) and unanimouſly agree to allow their foreign Partners ſuch a Share of the Prize (if taken) as ſhall ariſe from an imaginary Stock of 4 Guineas *per* Man, provided they may be allow'd the Uſe of their Cabin till the Enemy's Fury is ſomewhat abated, promiſing to aſcend in proportion as the Enemy's Colours ſhall deſcend; to this the fighting Partners agree: Now,

the Prize being taken, and found worth 1128 *l.* 'tis requir'd to determine each Man's Share, according to *Malcolm*'s Rule for Factorage (ſee the Preface) allowing 3 *Britons* as much as 2 *Hibernians*, and 3 *Pruſſians* as much as 5 *Britons?* Anſwer, a *Briton* 12 *l.* a *Hibernian* 18 *l.* a *Pruſſian* 20 *l.* and a *Swede* 0.

The End of the FIRST VOLUME.